



**ADAT Proprietary
Synchronization Specification**

**Document Version 9.01
Last Revised: 5/31/2001**

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- + Indicates significant correction from previous specification (March 1996).
- = Indicates that the section indicated is out of date and should be avoided in future implementations.
- # Indicates that the section is not supported by the HD24 and possibly other ADATs.

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A. Warnings

This document is in development. Currently it contains terrible grammar, incorrect section references, inconsistencies, ugly formatting and probably other bad things. **It is for Alesis internal use only.** Please contact Peter Maresh (pmaresh@alesis.com, x3565) with any questions/comments/obscenities so that these bad things can be eliminated. This section should be deleted when document reaches revision 9.1.

1. Scope

1.1 Scope of this document

The document that follows fully specifies the format of the Alesis Proprietary Synchronization Interface (US Patent 5,541,781), to be used for interconnection of multiple digital audio devices for the purpose of synchronizing sample clocks and sample location, as well as machine control communication. It is intended to promote familiarity with the Alesis format and encourage interconnection compatibility of digital audio equipment manufactured and marketed by different suppliers.

1.2 Reason for this revision

This document was revised to fix errors in the March 1996 version of this document. This revision also adds examples and more thorough discussions of the usage of each command, including specific instructions on how MIDI Machine Control (MMC) should be integrated with the Alesis Synchronization (Sync) messages.

2. Introduction

The Alesis Proprietary Synchronization Interface was designed as a simple and reliable system to synchronize multiple digital audio systems through a 9-pin connector. This interface is designed to be inexpensive, but provides for sample accurate synchronization, 24 hour time code, and complete machine control capability.

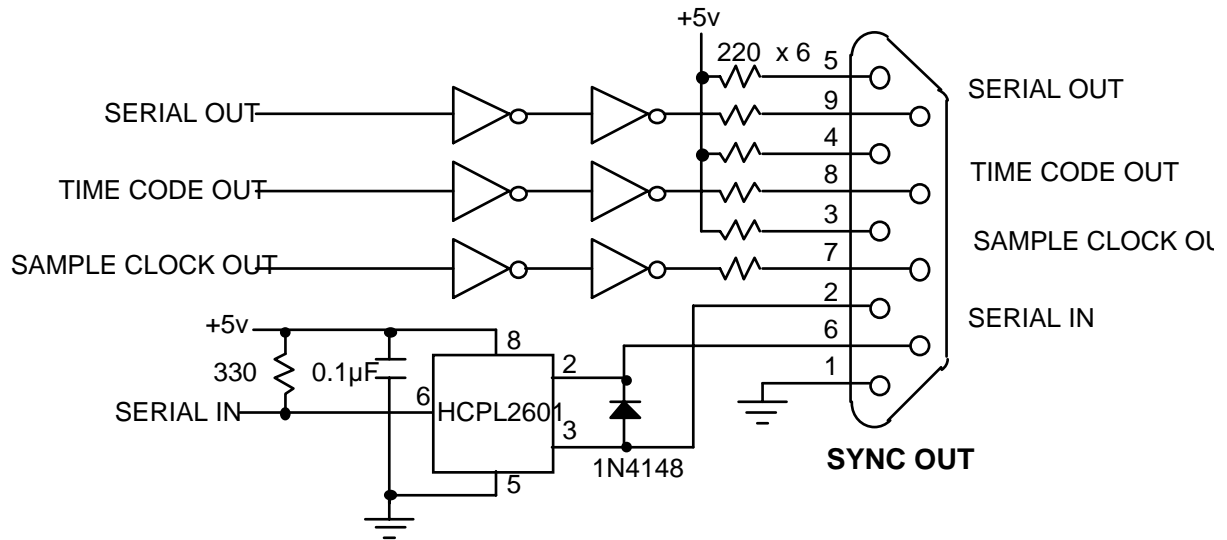
This interface is used for synchronizing multiple ADATs together, but could also be used as an interface for synchronizing to digital audio workstations, analog tape recorders, MIDI systems, computers, etc.

3. Electrical Specification

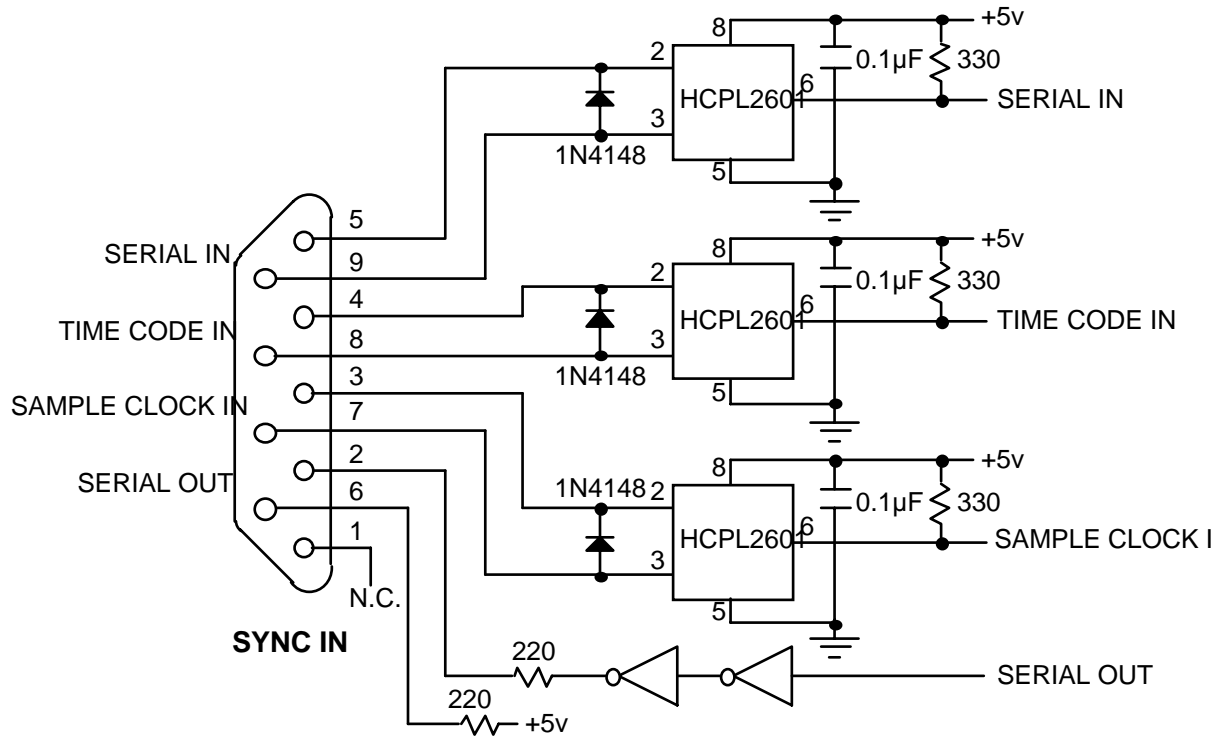
The synchronization information is connected via a standard 9-pin D type connector. Separate 9-pin connectors are provided for Sync In and Sync Out. The Sync In is used for receiving timing information (Slave), and the Sync Out is used for sending timing information (Master). Two pins each are used for the following four signals: Time code, Sample clock, Serial in, and Serial out. Each of these four signals is an optically isolated 5mA current loop so as to prevent ground loops between products. Note that this current loop design can work with both 5V and 3.3V rails with appropriate modifications (examples below use 5V rails). Logic 0 is represented when current is on. The ninth pin is used for circuit ground only on the Sync Out connector for shielding purposes. Both the casing and pin one of the Sync In connector must be left unconnected.

The connection diagrams are pictured below.

3.1 Sync Out circuit example



3.2 Sync In circuit example

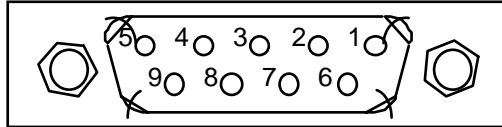


The opto-isolators shown are Texas Instruments HCPL2601. Other opto-isolators can be used with appropriate changes. Since these signals may have to pass through up to 16 machines, opto-isolators commonly used for MIDI are not recommended due to the amount of slew introduced to the signal.

3.3 Connector Pinout

The connectors for both the Sync In and Sync Out are female 9-pin D type connectors. The pinout of the connector is shown below.

CONNECTOR PINOUT- REAR PANEL VII



4. Sample Clock Specification

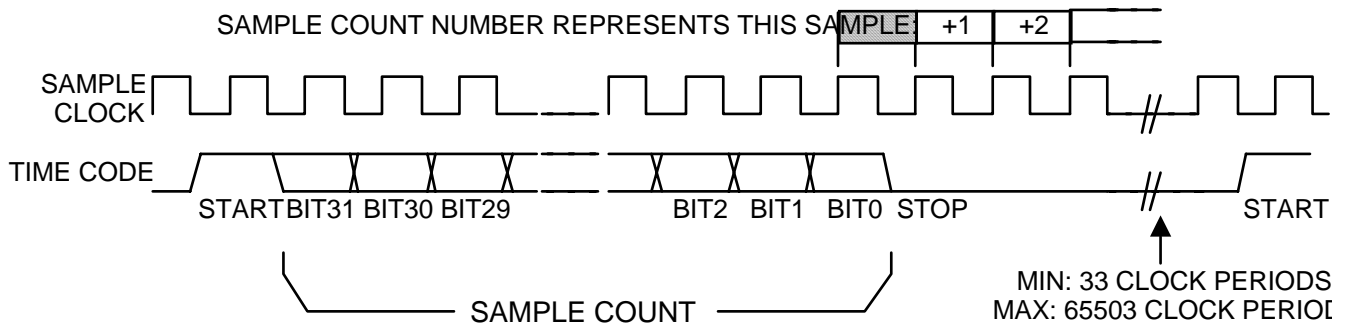
The sample clock is a square wave with one period equal to the current sample rate. In the ADAT, the nominal speed of the Sample Clock is 48KHz. The ADAT's pitch range is from +1 semitone to -3 semitones. This equates to a sample rate range of 50.854KHz to 40.363KHz. Rates outside of this range are not recommended.

It is recommended that the rate of change of the sample rate should not exceed 2 seconds per semitone. This figure reflects the ability of older tape machines to remain in lock while the timecode is changing. If this is not of importance, faster rates can be used.

The Master must ALWAYS provide sample clock (even when a different clock is being used for the converter sample clock) for purposes of the attached Slaves detecting when the Master has been disconnected. See Section 6.4.1 on Sync chain configuration.

5. Timecode Specification

The time code is a serial bit stream that contains a start bit and 32 data bits. The serial data is clocked out on the falling edges of the Sample Clock, and therefore can be clocked in using the rising edges of the Sample Clock. This timecode consists of a 32-bit absolute sample count from the beginning of each ADAT tape. 32 bits of sample count at 48KHz sample clock allows for an absolute time count range of 24 hours, 51 minutes, and 18.485 seconds. The start bit is logic high, followed by the 32 time code bits (most significant bit first), followed by a minimum of 33 clocks of logic low. In order to unambiguously recognize the start bit of a time code, at least 33 clocks of logic low must occur between time code transmissions. Although the time code takes 33 sample clocks to transmit, it represents the sample count of only the last sample clock of the 33 sample clocks. It is the responsibility of the receiving device to continue to count sample clocks in order to determine the exact sample count number of any arbitrary sample clock. No more than 65,503 clocks of logic low can occur between time code transmissions. This is due to the fact that there is a 16-bit counter in the ADAT that counts sample clocks between the receipt of each time code. The format of the time code looks as follows:



In the ADAT, the time code will be transmitted once per 960 sample clocks. However, it is assumed that all devices (including ADATs) can synchronize to time code received a maximum of once per 66 clocks and a minimum of once per 65536 clocks. See Section 6.5.1 concerning deviant behavior in regard to this specification.

The time code being transmitted is only assumed to be valid while the sending device is currently playing or recording. At any other time, the time code should be ignored and location information should be obtained from the serial in.

Note: Since this time code represents absolute tape location in the ADAT, the time code at ADAT tape counter location 00:00 will actually be two minutes worth of samples at 48kHz (57E400H or 5,760,000 decimal) due to the configuration data that exists at the beginning each ADAT tape.

6. Serial Communication Protocol

The serial out signal operates at 31.25 ($\pm 1\%$) Kbaud, asynchronous, with a start bit, 8 data bits (D0 to D7), and a stop bit. This makes a total of 10 bits for a period of 320 microseconds per serial byte. The start bit is a logical 0 (current on) and the stop bit is a logical 1 (current off). Bytes are sent LSB first. This format is consistent with the MIDI 1.0 specification. The hardware requires a faster optoisolator than the specification requires, due to the possibility of the signal having to pass through 16 optoisolators and remain valid.

The communication protocol is designed to rely on a subset of the MIDI 1.0 specification and the MIDI Machine Control 1.0 Recommended Practice RP-013. Although ADATs only use a subset of these commands, any legal MIDI transmission can be passed through the serial communication interface. The ADAT will respond only to specific MIDI Machine Control (MMC) and System Exclusive (Sysex) commands which have been received by the serial input of the Sync In port. However, the ADAT will transmit all messages it receives at the serial in of the Sync In port out the serial output of the Sync Out port, both messages it recognizes and messages it doesn't. The serial output of the Sync In port is used only for responding to specific messages received from the serial input of the Sync In port, and for passing all messages received at the serial input of the Sync Out port (when configured to do so). The serial input of the Sync Out port is used only for receiving specific responses to messages previously sent out the serial out of the Sync Out port. This section includes descriptions of all commands used by ADAT Sync. See Section 6.4 on ADAT Sync Usage for details on how these commands are used to perform tasks, and specific details about when messages are passed from Sync In to Sync Out and vice versa.

The following tables show the messages that can be received and/or sent out by the ADAT.

- Note:
- 1) Items in curly brackets, {}, can be repeated multiple times
 - 2) Items in square brackets, [], are optional, depending upon preceding info
 - 3) Items in angle brackets, <>, are variables (variable data).
 - 4) The following are section comments:
 - + Indicates significant correction from previous specification (March 1996).
 - = Indicates that the section indicated is out of date and should be avoided in future implementations.
 - # Indicates that the section is not supported by the HD24 or possibly other ADATs.
 - 5) All numbers are shown in hex, unless otherwise noted.

6.1 ADAT System Exclusive

In addition to MIDI Machine Control (MMC) commands, the ADAT responds to and sends out Alesis sysex commands to access functions that are not addressed by MMC commands. Responses represent the message that would be sent out an ADAT's serial out of its Sync In port after receiving the previous message in its serial in of its Sync In port.

The ADAT has the following MIDI System Exclusive format:

F0	Start-of-Exclusive
00 00 0E	Alesis manufacturer ID
08	ADAT product ID
aa	Device id# (0..0FH, 7EH=unassigned, 7FH=all)
bb	Opcode (0..7FH)
data	MIDI data (0..7FH)
F7	End-of-Exclusive

Note: The ADAT switch/flag values vary by system. For all bytes which represent variables which have ONLY two values, it is highly recommended that zero/non-zero detecting code is used. Although the specification often dictates that the flag be represented by 00H (FALSE) or 7FH (TRUE), many ADATs use 00H (FALSE) or 01H (TRUE), instead.

6.1.1 ADAT Sysex - System Configuration and Master/Slave Inquiry Commands (01 to 1F)

01 - Primary Polling

F0 00 00 0E 08 7F 01 F7

Description: All slaves reset sync configuration and respond to secondary polling query.

Response: None.

Usage Notes: See Section 6.4.1 on Sync chain configuration.

02 - Secondary Polling

F0 00 00 0E 08 7F 02 F7

Description: Query only **new** machines in sync chain.

Response: Only newly connected ADATs **without** device id number should respond.

F0 00 00 0E 08 00 42 F7

Usage Notes: See Section 6.4.1 on Sync chain configuration. Since ADAT polling is every 750ms, this command is also used to synchronize display blinking. When this command is received, any currently blinking indicators turn on for 500ms, then off for 250ms.

03 - Identification Query

F0 00 00 0E 08 7E 03 F7

Description: Query only **new** machines in sync chain.

Response: Only newly connected ADATs **without** device id number should respond.

F0 00 00 0E 08 00 41 F7

Usage Notes: See Section 6.4.1 on Sync chain configuration.

04 - Existence

F0 00 00 0E 08 <dev#> **04** F7

<dev#> - Single Device (0..0F)

Description: Query only **old** machines in sync chain.

Response: Only newly connected ADATs **with** device id number should respond.

F0 00 00 0E 08 00 **43** F7

Usage Notes: See Section 6.4.1 on Sync chain configuration. This command is essentially the shortest status query, giving information only to the effect that the slave is still alive. A response to any other status query confirms this as well, making this command a poor choice for applications where other status information is useful.

05 - Device Identification Assignment

F0 00 00 0E 08 7E **05** <dev#> F7

<dev#> - New device assignment (00..0F)

Description: Assign a new device a new device id

Response: None.

Usage Notes See Section 6.4.1 on Sync chain configuration. Only newly connected ADATs **without** device id number should update their ID.

06 - Define Device Mode

F0 00 00 0E 08 <dev#> **06** <select> F7

<dev#> - Any device (00..0F, 7F)

<select> - 0sss 0ccc

Sync Out Select (0sss):

0=no change

1=Out - output internal clock and timecode to Sync Out

2=Thru - pass clock and timecode from Sync In to Sync Out

Clock Select (0ccc):

0=no change

1=Int48K - sync to internally generated clock

2=Ext48K - sync to externally generated clock from Sync In

3=Dig48K - sync to clock from digital optical input

Description: Configure Sync Out timecode and clock select.

Response: None.

Usage Notes: This is used by the BRC to enable slaves to synchronize to the first ADAT slave, rather than the BRC whose timecode is determined by the fist ADAT slave. The BRC enables the first slave of the chain to send out its internal timecode and clock until the first slave has achieved synchronization with the BRC. Once the first slave and the BRC are synchronized, the BRC switches the first slave's configuration to pass through timecode and sample clock.

07 - Software Version Query = #

F0 00 00 0E 08 <dev#> **07** F7

<dev#> - Single Device (0..0F)

Description: Request software version.

Response:

F0 00 00 0E 08 00 **44** <versionH> <versionL> F7

<versionH> - 0aaaaaaaa = integer part (0..99)

<versionL> - 0bbbbbbb = fractional part (0..99)

Usage Notes: Because the BRC behaves badly when it receives a software version that it does not know, this command has no practical purpose when used with a BRC. The response to this command should always be 4.03, which is the latest ADAT Sync software version supported by the BRC.

08 - Synchronize

F0 00 00 0E 08 <dev#> **08** F7

<dev#> - Any device (00..0F, 7F)

Description: Synchronize to Sync In timecode.

Response: None.

Usage Notes: This command should be sent when master's transport is moving and timecode is stable for slaves to sync to. Slaves should not chase timecode until they receive this command. Slaves should stay synchronized until another appropriate transport command is received from the Sync master (Locate, Rewind, Stop etc). If the user Stops a slave from the front panel, but no command is received from the Sync master, as soon as the slave enters play mode again, it should re-synchronize without a message from the master.

09 - Tape Location Query

F0 00 00 0E 08 <dev#> **09** F7

<dev#> - Single Device (0..0F)

Description: Request 32 bit timecode.

Response: See Section 6.1.4 on ADAT Sysex Responses.

Usage Notes: Note that because of the 2 minute (@ 48k) header used by ADAT tapes, reported timecode must have 0057E400H (or 5,760,000 decimal) added to its reported timecode. Likewise, when receiving timecode, this amount must be subtracted.

0A - Record Switch Disable #

F0 00 00 0E 08 <dev#> **0A** <value> F7

<dev#> - Any device (00..0F, 7F)

<value> - 0=enabled; 7F=disabled

Description: Disable record from front panel.

Response: None.

0B - ADAT Polling Disable +

F0 00 00 0E 08 <dev#> **0B** <value> F7

<dev#> - Any device (00..0F, 7F)

<value> - 0=polling disabled; 7F=polling enabled

Description: Disable polling for slaves.

Response:

Ack F0 00 00 0E 08 00 **4D** F7

Usage Notes: This command is not intended for use with slaves, it is one of the few commands accepted by a master ADAT. Polling disable is used by MIDI to Sync interfaces that pose as both the Master and Slave, and do not need polling commands.

0C - BRC Control = #

F0 00 00 0E 08 <dev#> **0C** <value> F7

<dev#> - Any device (00..0F, 7F)

<value> - 0=disable; 7FH=enable

Description: Command unknown.

Response: None.

0D - Tape Status Query

F0 00 00 0E 08 <dev#> **0D** F7

<dev#> - Single Device (0..0F)

Description: Request tape status.

Response:

F0 00 00 0E 08 <dev> **47** <type> F7

<type> - 0=no tape in drive

1=formatted, writeable

2=formatted, write-protected

3=unformatted, writeable

4=unformatted, write-protected

0E - Status Query

F0 00 00 0E 08 <dev#> **0E** <type> F7

<dev#> - Single Device (0..0F)

<type> - 0="Status Query 0"

1="Location and Status Query 1"

2="Status Query 2"

3="Status Query 3"

Response: See Section 6.1.4 on ADAT Sysex Responses.

0F - Sync Status Query

F0 00 00 0E 08 <dev#> **0F** F7

<dev#> - Single Device (0..0F)

Description: Request synchronization status.

Response:

F0 00 00 0E 08 <dev> **49** <value> F7

<value> - 0=not in sync, 7FH=in sync

Usage Notes: It is often more useful to use a Status Query instead, Particularly Status Query 0, which will provide more information using only slightly more bandwidth.

10 - Format 0 Prepare #

F0 00 00 0E 08 <dev#> **10** F7

<dev#> - Any device (00..0F, 7F)

Description: Master is performing a complete format. Slaves should rewind to start-of-tape and await further command.

Response: None.

Usage Notes: This command is used to format tape, and should only be handled by tape or tape-like machines.

11 - Format 0 Position Query

F0 00 00 0E 08 <dev#> **11** F7

<dev#> - Single Device (0..0F)

Description: Query to see if slaves are ready for format.

Response:

F0 00 00 0E 08 00 **45** <value> <dev#> F7

<value> - 0=not ready, 7F=ready

<dev#> - This device (00..0F)

Usage Notes: This command is used to format tape, and should only be handled by tape or tape-like machines, non-tape machines should always respond "ready".

12 - Release Tape Format Timecode Reset #

F0 00 00 0E 08 <dev#> **12** F7

<dev#> - Any device (00..0F, 7F)

Description: Command unknown.

Response: None.

Usage Notes: This command is used to format tape, and should only be handled by tape or tape-like machines.

13 - Record 0 #

F0 00 00 0E 08 <dev#> **13** F7

<dev#> - Any device (00..0F, 7F)

Description: Master is beginning format.

Response: None.

Usage Notes: This command is used to format tape, and should only be handled by tape or tape-like machines.

14 - Unthread

F0 00 00 0E 08 <dev#> **14** F7

<dev#> - Any device (00..0F, 7F)

Description: Place transport into unthreaded position.

Response: None.

Usage Notes: Non-tape machines should still correctly react to this command to maintain BRC compatibility. For example, for a locate of greater than 3 minutes, the BRC requests that all slaves unthread, and polls for status before issuing the locate command.

15 - End of Tape = #

F0 00 00 0E 08 <dev#> **15** F7
<dev#> - Any device (00..0F, 7F)
Description: Master hit the end of tape
Response: None.
Usage Notes: This command is obsolete.

16 - Locate =

F0 00 00 0E 08 <dev#> **16** <loc#> [<timecode>] F7
<dev#> - Any device (00..0F, 7F)
<loc#> - 0..2=loc0..loc2,
3=locate to following timecode
4=crude locate to following timecode (used
when chasing to a varispeed deck/timecode)
<timecode> - 32-bit timecode transferred as 5 bytes
Description: Locate to internal locate point or provided timecode. Recall
2 minutes ADAT offset. Locate 0 is always the start of the tape
in absolute mode, but the Locate 0 point in relative mode.
Response: None.
Usage Notes: Loc1 to Loc2 and 04 (crude locate) are under
consideration for removal.

17 - Write Tape #

F0 00 00 0E 08 <dev#> **17** <count msb> <count lsb> F7
<dev#> - Any device (00..0F, 7F)
<count> - # of bytes to be stored to tape
(max=25,856)
Description: Request that slaves prepare to receive BRC configuration
data via Sysex.
Responses:
Ack F0 00 00 0E 08 00 4D F7
Nak F0 00 00 0E 08 00 4E F7
(if not at start of tape or count>25,856)
Usage Notes: See below.

18 - Read Tape #

F0 00 00 0E 08 <dev#> **18** F7
<dev#> - Single Device (0..0F)
Description: Request that slave sends BRC configuration data via Sysex.
Possible Response:
Fail F0 00 00 0E 08 00 4F F7
Usage Notes: See below.

NOTE: Commands 17 & 18 are used by the BRC in order to save and load locate information to and from the tape header. It is not recommended that other products utilize these codes. Non-tape based machines or any machine not designed to work with the BRC should respond NAK or FAIL.

19 - Tape Type =

F0 00 00 0E 08 <dev#> **19** <value> F7
<dev#> - Any device (00..0F, 7F)
<value> - 0=Std1
 1=Std2 (large hub)
 2=T-160 (thin tape)

Description: Inform slaves of master's tape type. This command should only be handled by tape or tape-like machines.

Response: None.

1A - Internal Sync Offset = #

F0 00 00 0E 08 <dev#> **1A** [<timecode>] F7
<dev#> - Any device (00..0F, 7F)
<timecode> - 32-bit timecode (a=msb, d=lsb)
a7 a6 a5 a4 a3 a2 a1 a0 transfer as 00 a6 a5 a4 a3 a2 a1 a0
b7 b6 b5 b4 b3 b2 b1 b0 00 b5 b4 b3 b2 b1 b0 a7
c7 c6 c5 c4 c3 c2 c1 c0 00 c4 c3 c2 c1 c0 b7 b6
d7 d6 d5 d4 d3 d2 d1 d0 00 d3 d2 d1 d0 c7 c6 c5
 00 00 00 00 d7 d6 d5 d4

Description: Set Sync timecode offset.

Response: None.

Usage Notes: Specifically for Digidesign products. The maximum offset allowed is 7440h samples.

6.1.2 ADAT Sysex – Toggle Commands (20 to 2F)

20 - All Input =

F0 00 00 0E 08 <dev#> **20** <value> F7

<dev#> - Any device (00..0F, 7F)

<value> - 0=disable; 7FH=enable

Description: Set All Input.

Response: None.

Usage Notes: Redundant with Global Monitor MMC (50) command.

Should use MMC command for general compatibility purposes.

See Section 6.3 for MMC compatibility.

21 - Auto Input =

F0 00 00 0E 08 <dev#> **21** <value> F7

<dev#> - Any device (00..0F, 7F)

<value> - 0=disable; 7FH=enable

Description: Set Auto Input.

Response: None.

Usage Notes: Redundant with Record Monitor MMC (51) command.

Should use MMC command for general compatibility purposes.

See Section 6.3 for MMC compatibility.

22 - Auto Return (Auto 2>1)

F0 00 00 0E 08 <dev#> **22** <value> F7

<dev#> - Any device (00..0F, 7F)

<value> - 0=disable; 7FH=enable

Description: Sets Auto Return INDICATOR ONLY.

Response: None.

Usage Notes: In ADAT Sync chains, the master assumes full

responsibility for sending all transport commands related to Auto

Play/Return/Loop. Therefore, this command is used only so that

slave ADAT displays match the master ADAT display. Note that

Auto Loop is Auto Return and Auto Play together, and that locate

points must be valid for Auto Loop to be active.

23 - Auto Play

F0 00 00 0E 08 <dev#> **23** <value> F7

<dev#> - Any device (00..0F, 7F)

<value> - 0=disable; 7FH=enable

Description: Sets Auto Play INDICATOR ONLY..

Response: None.

Usage Notes: See Auto Return above.

- 24 - Digital Select/Enable (Input Toggle)**
 F0 00 00 0E 08 <dev#> **24** <value> F7
 <dev#> - Any device (00..0F, 7F)
 <value> - 0=disable (analog); 7FH=enable (digital)
 Description: Toggle between analog and digital inputs.
 Response: None.
 Usage Notes: Although somewhat useful as an analog/digital toggle, this command is primarily used for selecting the ADAT optical inputs to configure digital bussing and loop modes. Since most machines have *multiple* input/output options, this command is useless as an input select toggle.
- 25 - Format Ready on/off #**
 F0 00 00 0E 08 <dev#> **25** <value> F7
 <dev#> - Any device (00..0F, 7F)
 <value> - 0=disable; 7FH=enable
 Description: This command is used to format tape, and should only be handled by tape or tape-like machines.
 Response: None.
- 26 - Absolute Display Mode #**
 F0 00 00 0E 08 <dev#> **26** <value> F7
 <dev#> - Any device (00..0F, 7F)
 <value> - 0=relative; 7FH=absolute
 Description: Switches between absolute and relative timecode displays.
 Response: None.
 Usage Notes: Should be used in conjunction with setting Locate 0, which is the locate point which determines the relative display start point.
- 27 - Write Format (Input Mute) + #**
 F0 00 00 0E 08 <dev#> **27** <value> F7
 <dev#> - Any device (00..0F, 7F)
 <value> - 0=disable; 7FH=enable
 Description: If enabled, ignore input and write 0's to tape. This command is used to format tape, and should only be handled by tape or tape-like machines.
 Response: None.
- 28 - Digital Thru Mode**
 F0 00 00 0E 08 <dev#> **28** <value> F7
 <dev#> - Any device (00..0F, 7F)
 <value> - 0=disable; 7FH=enable
 Description: All digital inputs should be linked directly to digital outputs.
 Response: None.
- 29 - "ALL CALL" Commands Status = #**
 F0 00 00 0E 08 <dev#> **29** <value> F7
 <dev#> - Any device (00..0F, 7F)
 <value> - 0=ignore; 7FH=respond
 Description: Command unknown.
 Response: None.

6.1.3 ADAT Sysex – Parameter Edit Commands (30 to 3F)

30 - Tape Offset Time

F0 00 00 0E 08 <dev#> 30 <timecode> F7

<dev#> - Any device (00..0F, 7F)

<timecode> - 32-bit timecode transferred as 5 bytes:

a7 a6 a5 a4 a3 a2 a1 a0	transfer as	00 a6 a5 a4 a3 a2 a1 a0
b7 b6 b5 b4 b3 b2 b1 b0		00 b5 b4 b3 b2 b1 b0 a7
c7 c6 c5 c4 c3 c2 c1 c0		00 c4 c3 c2 c1 c0 b7 b6
d7 d6 d5 d4 d3 d2 d1 d0		00 d3 d2 d1 d0 c7 c6 c5
sn=sign (0=positive, 1=negative)		00 00 00 sn d7 d6 d5 d4

Description: Sets tape offset time from incoming timecode.

Response: None.

Usage Notes: The purpose of this command is to enable ADAT tapes with different song start points to start playing at the same time.

31 - Transfer Locate Points =

<dev#> - Any device (00..0F, 7F)

F0 00 00 0E 08 <dev#> 31 <data> F7

<data> - 1 = Copy GP01 --> Loc0

2 = Copy GP02 --> Loc1

3 = Copy GP03 --> Loc2

(GPxx = MMC General Purpose location xx)

Description: Transfer MMC Locate points to ADAT locate points. Note that Loc0 is the relative time location, Loc1 and Loc2 generally designated Loop Start and Loop End Locate points.

Response: None.

Usage Notes: Since the MMC locate points do not include 21 and 22, the locate points used for Auto Punch In/Out, and since Loop Start and Loop End are generally handled by the master (no locates need to be stored on the Slave machine), this command is out of date.

32 - Delay Time

<dev#> - Any device (00..0F, 7F)

F0 00 00 0E 08 <dev#> 32 <track#><countH><countL> F7

<track> - 0..7

<countH> - 00aaaaaa where aaaaaa = count<C..7>

<countL>- 0bbbbbbb where bbbbbbb = count<6..0>

Description: Adjust individual track delays. The valid value ranges is 0 thru 8191 decimal (0 to 170ms @ 48kHz).

Response: None.

33 - Digital Routing

<dev#> - Any device (00..0F, 7F)
F0 00 00 0E 08 <dev#> **33** [<data1> <data2>] F7
<data1> - 0ccc xxxx where
 ccc = 0..7 (source chan 1-8)
 xxxx = ms nibble of dest bitmap
<data2> - 0000 yyyy where
 yyyy = ls nibble of dest bitmap
Routing bitmap --> bit0=chan1...bit7=chan8
(bit set=output dest)

Description: Used for routing which digital input is routed to which digital output. Note:

- The <data1><data2> pair can be repeated several times within one message, thus allowing for multiple channel routings to be defined.
- This routing determines where each digital input received from the digital optical port will be routed. A single digital input channel can be routed to up to eight ADAT channels.

Response: None.

34 - Output Attenuation =

<dev#> - Any device (00..0F, 7F)
F0 00 00 0E 08 <dev#> **34** <value> F7
<value> - 0 = 0 dB 4 = -24 dB
 7 = -6 dB 3 = -30 dB
 6 = -12 dB 2 = -36 dB
 5 = -18 dB 1 = -42 dB

Description: Reduce the level of the output. The amount of output attenuation affects all 8 channels simultaneously. The meters will not reflect the attenuated audio. The meters reflect the level of the audio recorded on tape, not the level at the outputs.

Response: None.

35 - Crossfade Time

<dev#> - Any device (00..0F, 7F)
F0 00 00 0E 08 <dev#> **35** <time> F7
<time> - 0 = 10.67 ms
 1 = 21.33 ms
 2 = 32.00 ms
 3 = 42.67 ms

Description: Adjust crossfade time for punches and edits.

Response: None.

36 - Pitch

F0 00 00 0E 08 <dev#> **36** <deltaL> <deltaH> F7
<dev#> - Any device (00..0F, 7F)
<deltaL> - 0aaaaaaaa aaaaaa = pitch delta <6..0>
<deltaH> - 00000sbb
bb = pitch delta <8,7>
s = sign bit (0 = pos, 1 = neg)
range: +100 thru -300 decimal
(64h, s=0 thru 12Ch, s=1)

Description: Display pitch change.

Response: None.

Usage Notes: Since the sample rate is fixed by the incoming sample clock via the sync cable, this command is used only so that the machine can correctly display the current pitch. Also can be used to determine the base sample rate.

37 - Set Locate Point =

F0 00 00 0E 08 <dev#> **37** <loc#> <timecode> F7
<dev#> - Any device (00..0F, 7F)
<loc#> - 0..9=Loc0..Loc9
15 (21 decimal)=auto punch-in loc
16 (22 decimal)=auto punch-out loc
<timecode> - 32-bit timecode transferred as 5 bytes

Description: Set internal locate point to transmitted timecode.

Response: None.

Usage Notes: Loc0 is used for relative timecode display. Note that Loc3 to Loc9 are available only on XT, LX and later machines, and that Loc21 and Loc22 (Punch In/Out) are automatically transferred to Loc3 and Loc4 on ADAT XT and LX machines. See Section 6.4.3 on Auto Record (Auto Punch).

38 - Auto Punch/Record (Write Misc Options) + =

F0 00 00 0E 08 <dev#> **38** <value> F7
<dev#> - Any device (00..0F, 7F)
<value> - 0=disable; 7FH=enable
enable: When playing, punch-in at auto punch-in locate point
disable: When recording, punch-out at auto punch-out locate point

Description: Start or turn off. Auto Punch (Auto Record). See Section 6.4.2 on Auto Punch (Auto Record).

Response: None.

Usage Notes: When enabled, turns on Auto Record and should also be considered a Record Strobe. When disabled, Auto Record is disabled but record mode is NOT exited. If in record pending mode, then record is exited.

39 - Master "Assume" Command = #

F0 00 00 0E 08 <dev#> **39** <options> F7

<dev#> - Single device (00..0F)

<options> - 000naaaa

n = 1 "assume" master

aaaa = 0 - 16 adats connected

Description: Obsolete. Performs same task as Define Device Mode (06). Turning Master Assume on enables the recipient to output its own timecode and clock, instead of passing the master's timecode and clock.

Responses:

Ack F0 00 00 0E 08 00 **4D** F7

Nak F0 00 00 0E 08 00 **4E** F7

Usage Notes: Originally designed to be used by the BRC to enable slaves to sync faster, but was replaced with the simpler Define Device Mode (06).

6.1.4 ADAT Sysex – Responses (40 to 4F)

41 - Identification Response

F0 00 00 0E 08 00 41 F7

Description: Response to Identification Inquiry (03).

42 - Polling Response

F0 00 00 0E 08 00 42 F7

Description: Response to Secondary Poll (02).

43 - Exist Response

F0 00 00 0E 08 00 43 F7

Description: Response to Existence Query (04).

44 - Software Version Response

F0 00 00 0E 08 00 44 <version> <revision> F7

<version> - 0..99 integer part

<revision> - 0..99 fractional part

Description: Response to Version Query (07). This response must be 4.03.

45 - Format Position Response

F0 00 00 0E 08 00 45 <value> <dev#> F7

<value> - 0=not ready, 7F=ready

<dev#> - this device (00..0F)

Description: Response to Format Ready Query (11).

46 - Tape Location Response

F0 00 00 0E 08 00 46 <type> [<timecode>] F7

<type> - 0=unformatted, 1=estimated time,

2=real time, 3=tape start, 4=tape end

<timecode> - 32-bit timecode (a=msb, d=lsb)

a7 a6 a5 a4 a3 a2 a1 a0 transfer as 00 a6 a5 a4 a3 a2 a1 a0

b7 b6 b5 b4 b3 b2 b1 b0 00 b5 b4 b3 b2 b1 b0 a7

c7 c6 c5 c4 c3 c2 c1 c0 00 c4 c3 c2 c1 c0 b7 b6

d7 d6 d5 d4 d3 d2 d1 d0 00 d3 d2 d1 d0 c7 c6 c5

00 00 00 00 d7 d6 d5 d4

If <type>=0, then no timecode value sent

Description: Response to Tape Location Query (09).

Usage Notes: The BRC behaves badly when receiving type 04 (end of tape) from this command and does not issue further Locate commands whenever the Locate is greater than 3 minutes. It is suggested that the response be 04 (end of tape) once, and that further replies be 02 (real time).

47 - Tape Status Response

F0 00 00 0E 08 <dev> 47 <type> F7

<type> - 0=no tape in drive

1=formatted, writeable

3=unformatted, writeable

2=formatted, write-protect

4=unformatted, write-protect

Description: Response to Tape Status Query (0D).

48 - Status Query Response

```
F0 00 00 0E 08 <dev> 48 <<type> <value> F7
<type> -
  0="Status Query0"
  1="TimeLine Status Query1"
  2="TimeLine Status Query2"
  3="Status Query3"
<value> -
  for type=0: <v1> <v2> <v3>
  for type=1: <pe> <cs> <TC type> [<timecode>]
  for type=2: <v1> <v2> <v3> <ms> <mp> <ss>
  for type=3: <v1> <v2> <v3> <ms> <mp> <sx> <v4>

<v1> - 0dcb aaaa
aaaa - state
      0=No tape
      1=Stopped (unthreaded)
      2=Stopped (threaded)
      3=Stopped (threaded, capstan engaged)
      4=Playing
      5=Rewinding
      6=Forwarding
      7=Recording
      8=Fast Forwarding
      9=Fast Rewinding

b - sync status      (1=In sync)
c - format status   (1=unformatted)
d - protect status  (1=write protected)

<v2> - 0 t1 eeeee
eeee - interpolation error count
      (ADAT clears count after sending response)
t1 - track 1 record status
     (1=track record enabled)

<v3> - 0 t8 t7 t6 t5 t4 t3 t2
t8..t2 - track 2 .. track 8 record status
        (1=track record enabled)

<pe> - pending event  00=Eject
      01=Stop
      02=Rewind
      03=Play
      04=Forward
      19=Punch
      1A=Play rewind (scan rewind)
      1B=Play forward (scan forward)
      1F=No pending event
```


<cs> - current state
 00=No tape
 01=Stopped (unthreaded)
 02=Stopped (threaded)
 03=Stopped (threaded, capstan engaged)
 04=Playing
 05=Rewinding
 06=Forwarding
 07=Recording
 08=Fast Forwarding
 09=Fast Rewinding
 0A=Forward scan
 0B=Rewind scan

<TC type> [<timecode>]
 Same as Tape Location query response.

<ms> - same as MMC Motion Control Tally State
<mp> - same as MMC Motion Control Tally Process
<ss> - same as MMC Motion Control Tally Status

<sx> - 0 bbb i1 aaa
 bbb, aaa - same as MMC Tally response.
 i1 - track 1 input status
 (1=track input enabled)
<v4> - 0 i8 i7 i6 i5 i4 i3 i2
 i8..i2 - track 2 .. track 8 input status
 (1=track input enabled)

Description: Response to Status Query (0E).

49 - Sync Response

F0 00 00 0E 08 <dev> **49** <value> F7
 <value> - 0=not in sync, 7FH=in sync

The following responses are only used for write and read to tape (17 & 18), and the polling disable command (0B):

4D - Ack (Acknowledge)

F0 00 00 0E 08 00 **4D** F7
 Description: Used for Write Tape (17) and Polling Disable (0B). See Section 6.1.1.

4E - Nak (No Acknowledge)

F0 00 00 0E 08 00 **4E** F7
 Description: Used for Write Tape (17) and Polling Disable (0B).

4F - Fail

F0 00 00 0E 08 00 **4F** F7
 Description: Used for Read Tape (18).

6.2 ADAT XT System Exclusive

ADAT XT System Exclusive takes advantage of new features available in the LX and XT series ADAT recorders. The ADAT XT responds to all Alesis system exclusive ADAT commands, as well as MIDI Machine Control (MMC) commands. In addition, the ADAT XT also responds to and sends out Alesis system exclusive ADAT XT commands to access functions that may or may not be addressed by ADAT or MMC commands.

The ADAT XT has the following MIDI System Exclusive format:

F0H	Start-of-Exclusive
00H 00H 0EH	Alesis manufacturer ID
14H	ADAT XT product ID
aaH	Device id# (0..7EH, 7FH=all)
bbH	Opcode(0..7FH)
data	Data
F7H	End-of-Exclusive

6.2.1 ADAT XT Sysex (01 to 1F)

01 - Write Parameter +

F0H 00H 00H 0EH 14H <dev#> 01H {<param><data>} F7H
<param> -

01 Sample Rate Select
<data> - 0=48 kHz, 1=44.1 kHz

02 Analog Mode Select
<data> - 0=chan1..chan8 --> chan1..chan8
(one-to-one)
1=chan1..chan4 --> chan5..chan8
2=chan1 --> odd chans (3,5,7)
chan2 --> even chans (4,6,8)

03 Peak Hold Mode
<data> - 0=Momentary Peak Hold
1=Infinite Peak Hold
2=No Peak Hold

04 Frame Display Mode
<data> - 0=Normal display mode
(last 2 digits = 1/100th seconds)
1=Frame display mode
(last 2 digits = frames @ 30 ND)

Description: Set various display parameters. Note that Sample Rate Select is a display function.

Response: None.

02 - Clear Display Peak

F0H 00H 00H 0EH 14H <dev#> 02H F7H

Description: Clear VU peaks.

Response: None.

05 - VU Peak Level Request = #

F0H 00H 00H 0EH 14H <dev#> **05H** F7H

Description: Request last VU peak value per channel since last request.

Response:

```
F0 00 00 0E 14 <dev> 42 <data> F7
<data> - <data1> <data2> <data3> <data4> <data5>
<data1> - 0 b2 b1 b0 a3 a2 a1 a0
<data2> - 0 d1 d0 c3 c2 c1 c0 b3
<data3> - 0 f0 e3 e2 e1 e0 d3 d2
<data4> - 0 g3 g2 g1 g0 f3 f2 f1
<data5> - 0 0 0 0 h3 h2 h1 h0
where a3..a0 = channel 1 peak
      h3..h0 = channel 8 peak
```

Usage Notes: Pseudo Running Status Protocol (all numbers in hex)
This was implemented in order to minimize the number of bytes transmitted when querying multiple machines.

Request VU peak values of dev1 thru devn

```
F0 00 00 0E 14 <dev1> 05 <dev2>..<devn> F7
```

Response of each device queried

```
<dev1> response --> F0 00 00 0E 14 <dev1> 42
<data>
<dev2> response --> <dev2> <data>
...
<devn> response --> <devn> <data>
```

The controller must wait for a response from each device before proceeding to the next device. An example follows:

```
- Controller:          F0 00 00 0E 14 00 05
Send query to device 00
- Device 00:          F0 00 00 0E 14 00 42 <data>
Device 00 response
- Controller:          01
Running status query to device 01
- Device 01:          01 <data>
Device 01 running response
- Controller:          02
Running status query to device 02
- Device 02:          02 <data>
Device 02 running response
- Controller:          F7      EOx
```

Usage Notes: This command has never been implemented in any ADAT, and uses an acceptable amount of bandwidth only when 3 machines (24 channels) or less are monitored.

07 - ADAT XT Software Version Inquiry

F0H 00H 00H 0EH 14H <dev#> **07H** F7H

Description: Request ADAT XT software version.

Response:

F0 00 00 0E 14 <dev> **44** <verH> <versL> F7
<verH> - 0aaaaaaaa = integer part (0..99)
<verL> - 0bbbbbbb = fractional part (0..99)

Usage Notes: For compatibility purposes, the ADAT XT also responds to the ADAT software version request with its ADAT software version equivalent (currently 4.03).

08 - Ignore Next XT Sysex Command = #

F0H 00H 00H 0EH 14H <dev#> **08H** F7H

Description: Command Unknown.

Response: None.

10 - Calibration Memory Dump #

F0H 00H 00H 0EH 14H <dev#> **10H** <data> F7H

<data> - 11 bytes of calibration values (9 bytes in MIDI data format)

data-01 = 00 a6 a5 a4 a3 a2 a1 a0
data-02 = 00 b5 b4 b3 b2 b1 b0 a7
data-03 = 00 c4 c3 c2 c1 c0 b7 b6
data-04 = 00 d3 d2 d1 d0 c7 c6 c5
data-05 = 00 e2 e1 e0 d7 d6 d5 d4
data-06 = 00 f1 f0 e7 e6 e5 e4 e3
data-07 = 00 f8 f7 f6 f5 f4 f3 f2
data-08 = 00 f15 f14 f13 f12 f11 f10 f9
data-09 = 00 g6 g5 g4 g3 g2 g1 g0
data-10 = 00 g13 g12 g11 g10 g9 g8 g7
data-11 = 00 00 00 00 00 00 g15 g14

a = Supply Soft Brake value (8 bits)

b = Takeup Soft Brake value (8 bits)

c = Supply Back Tension value (8 bits)

d = Takeup Back Tension value (8 bits)

e = Takeup Reel Slow value (8 bits)

f = Takeup Reel Speed value (16 bits)

g = PG Delay value (16 bits)

Description: Dumps calibration data to serial port.

Response: None.

Usage Notes: Not intended for use in a sync chain. Initiated from front panel by holding Set Locate and pressing Channel 6.

6.3 MIDI Machine Control (MMC) ADAT Sync Systems

Whenever possible, a MMC command is used for ADAT operation in order to maintain a maximum of compatibility with MMC devices. Please refer to the MIDI 1.0 Recommended Practice RP-103 document, available from the IMA for a description of MMC, MMC Information Fields, and other MIDI terminology, as well as specific information and syntax necessary for using MMC commands. The notes below do not give detailed syntax and usage information.

Note: When an ADAT source is compared to a MIDI source, the former refers to MMC commands sent as part of an ADAT Sync chain and used in conjunction with ADAT Sync commands. A MIDI source refers to a source (such as a sequencer) which does not provide ADAT Sync commands.

MIDI Machine Control (MMC) Format:

F0 7F	Universal System Exclusive Real Time header
aa	Destination (00 thru 7E, 7F=all call)
06	Machine Control Command (mcc)sub-id
bb	Command string (see <i>MMC document</i>)
F7	End-of-Exclusive

F0 7F	Universal System Exclusive Real Time header
aa	Destination (00 thru 7E)
07	Machine Control Response (mcr) sub-id
bb	Response string (see <i>MMC document</i>)
F7	End-of-Exclusive

6.3.1 MMC Sysex

The ADAT currently supports the following MMC commands/responses (MCS = Motion Control State, MCP = Motion Control Process):

01 - STOP (MCS)

Description: Stop and unthread.

Usage Notes: Non-tape based machines report unthreaded state.

02 - PLAY (MCS)

Description: Play.

Usage Notes: Slaves will remain unsynchronized and muted until ADAT Synchronize (08) command is issued. If master, after PLAY has been sent, issue a Synchronize command once timecode is stable.

03 - DEFERRED PLAY (MCS) =

Description: Play after all MCP's are complete.

Usage Notes: The ADAT implementation of DEFERRED PLAY is not compatible with MIDI RP document. DEFERRED PLAY is treated as a display command by ADATs, unless the machine has completed all MCPs. For example, if an ADAT is locating and it receives a DEFERRED PLAY message, then the ADAT will blink its PLAY indicator, indicating that it expects the next MCS will be PLAY. However, when the ADAT has finished its locate, it does NOT enter PLAY until a PLAY message is received from the master. If an ADAT receives a DEFERRED PLAY message and there are no pending MCPs, then it will PLAY immediately. Because of this inconsistency with the MIDI MMC RP document, it is recommended that DEFERRED PLAY not be used with ADATs to remain compatible with the MIDI MMC RP.

04 - FAST FORWARD (MCS)

Description: Fast Forward.

Usage Notes: Non-tape based machines should implement a fast forward scheme. Although in ADAT chains, since sample accurate locates and synchronization are used to keep machines aligned, the FAST FORWARD and REWIND commands are less important on slave machines, it is always desirable to have a fast forward and rewind scheme to have a uniform appearance in Sync chains while the user is using the master to find a location. In non-tape based machines it is possible to follow the ADAT timecode of the master, however this timecode is not always present, so some sort of ballistics are required when no timecode is detected.

05 - REWIND (MCS)

Description: Rewind.

Usage Notes: See FAST FORWARD above.

06 - RECORD STROBE

Description: Enter Record/Rehearse.

Usage Notes: Sync slaves must not enter Record/Rehearse until synchronized to the master. If a RECORD STROBE is received before a Synchronize command, then the slave should enter a Record Standby state. If an ADAT is in AUTO RECORD mode (see (38) AUTO RECORD), then the command is ignored.

07 - RECORD EXIT

Description: Exit Record.

09 - PAUSE (MCS)

Description: Enter stopped, threaded state.

Usage Notes: Non-tape based machines report threaded state.

0A - EJECT (MCS)

Description: Eject tape.

- 0D - MMC RESET**
Description: Reset MMC parameters.
- 40 - WRITE**
Description: Write MMC parameters. See Section 6.3.2.
- 41 - MASKED WRITE**
Description: Mask Write MMC parameters. See Section 6.3.2.
- 42 - READ**
Description: Read MMC parameters. See Section 6.3.2.
- 44 - LOCATE (MCP)**
Description: Locate to MMC Locate point or included timecode.
Usage Notes: Although this duplicates the ADAT Locate (16) command, this command is included for MMC compatibility with MMC generating sequencers and MIDI to ADAT Sync converters. MMC Locate should be avoided in chains which do not involve MIDI only devices because it is only accurate to the sub-frame level.
- 46 - SEARCH (MCS)**
Description: Playback at fractional speed.
Usage Notes: The ADAT implementation of SEARCH does not use speed information, only directional information, and causes ADATs to move at 3x speed either forward or backward playing bursts of audio.
- 4C - MOVE**
Description: Move MMC data from field to field. See Section 6.3.2.

6.3.2 MMC Information Fields

The ADAT currently supports the following MMC Information Fields:

01 - Selected TimeCode

Description: Current timecode.

Usage Notes: Short form must be updated at the same time.

08..0F - GP0/Locate Point..GP7

Description: Locate points 0 to 7.

Usage Notes: Short form must be written at the same time.

21 - Selected TimeCode (short form)

Description: Least significant portions of current timecode.

28..2F - GP0 (short form)..GP7 (short form)

Description: Least significant portions of locate points 0..7.

40 - Signature

Description: Command set signature of ADATs. The command set is as follows, and should be preceded by the field id and overall length (40 1B):

```
01 00 00 00
14
7E 4D 00 00 00 00 00 00 00 00
57 20 00 00 00 00 00 00 00 00
14
02 7E 03 00 00 02 7E 03 00 00
25 62 0F 00 00 00 00 00 00 00
```

42 - Response Error

Description: Response when a read of unsupported information field is attempted.

45 - Time Standard

Description: Default SMTPE time type.

48 - Motion Control Tally

Description: Current state of transport.

Usage Notes: Report unthreaded state as STOPPED, threaded state as PAUSED, and no tape state or state in which the machine is unable to perform transport functions should be reported as EJECT.

4C - Record Mode (Rehearse Enable)

Description: Set record/rehearse mode. ADATs respond to the following modes:

```
00 - Record disabled (write protect)
01 - Record (primary mode used by ADAT)
02, 05 - Record (used by VTR machines)
04 - Rehearse
7F - Use current setting
```


4D - Record Status

Description: Current record status.

4E - Track Record Status (Track Arm Status)

Description: Currently armed tracks. See (4F) Track Record Ready below.

4F - Track Record Ready (Arm Tracks)

Description: Change track arming.

Usage Notes: A length of 0 indicates "all safe." ADAT sync generally uses 2 bytes in order to accommodate the 8 tracks available on original ADAT systems, and when responding to queries from ADAT masters, 2 bytes should be used. Recorders using more than 8 tracks must represent themselves as multiple machines. However, when responding to MIDI sources, more than 2 bytes can be used, and more than 2 bytes should be handled.

50 - Global Monitor (All Input)

Description: Sets input monitor mode. ADATs respond to the following modes:

- 00 - Playback (All Input OFF)
- 01 - Input (All Input ON)
- 7F - Use current setting

Usage Notes: Note that there is an ADAT command that duplicates this function. The MMC command should be used, not the ADAT command.

51 - Record Monitor (Auto Input)

Description: Sets auto input monitor mode. ADATs respond to the following modes:

- 01 - Record or Non-Play (Auto Input OFF)
- 02 - Record or Record-Ready (Auto Input ON)
- 7F - Use current setting

Usage Notes: Note that there is an ADAT command that duplicates this function. The MMC command should be used, not the ADAT command.

6.4 ADAT Sync Usage

Multiple ADAT synchronization is possible because each ADAT can be assigned to pass all of the signals received at its Sync In port through to its Sync Out port. The single Master ADAT is at the top of the chain, and is responsible for configuring and controlling all the Slave ADATs. No Slave ADAT sends messages to the Master without being queried. This way, the Master is fully responsible for the behavior of the Slaves and the bandwidth used. The Master software can be robust, full featured and bandwidth heavy, or simple, easy to use, and low bandwidth. The sample clock, time code, and serial out of the Master will be connected to all of the Slaves, so that each Slave receives the same information from the Master, including messages. In addition, each Slave must pass all messages received at its serial in of its Sync Out port to the serial out of its Sync In port. This way, the Master can get responses from any of the Slaves. Each Slave is assigned a unique device number from the Master so that it can be addressed separately. Please see Section 6.4.1, Behavior as Master and Behavior as Slave below for specific descriptions of how ADATs should configure themselves and pass messages.

6.4.1 Chain Configuration

Initial Configuration

At power-on, all ADATs send an ADAT Primary Polling command (01). Each ADAT then monitors its serial input of the Sync In port to see if anything is connected to it. If it does not receive a polling command within 2 seconds, it assumes it is a Master and will proceed to configure any ADATs following it in the chain (if any exist). If it does receive a polling command, it knows it is a Slave and awaits further instruction. The Master configures the ADATs as follows:

- 1) Send ADAT Identification Inquiry command (03) to verify that there is a slave waiting to be assigned an ID.
- 2) Wait for slave to respond with Identification Inquiry Response(41). If no response within 2 seconds, then configuration is complete.
- 3) Assign lowest available device id to the Slave ADAT with Assign Device ID (05). It will then switch its Sync In port to go through to its Sync Out port, so that additional commands from the Master can be passed through to any additional connected slaves. Once a Slave has been assigned a device id, it will not respond to either the secondary polling or identification inquiry commands. It can be re-assigned by sending it a primary polling command and repeating the process.
- 4) Repeat 1-4 for each slave, until no response at step 2.

Adding New Slaves

After power on, the master periodically (every 750ms) sends out a Secondary Polling command (02) to check for newly connected slaves. When it receives a response, it does the following:

- 1) Send identification inquiry command (03) to verify slave ADAT.
- 2) Send existence command (04) to determine if previously connected slaves are still alive. Note that any command which requires a response, such as status requests (0E), will acceptably determine if a slave is still alive, and can be substituted for the Identification Inquiry command (03). If no response within 30ms, it is assumed that the slave is no longer connected (or powered on), so it decrements the device id and repeat existence command, until it has checked all slaves.
- 3) Assign the new slave the lowest device id not currently in use.

Although it is always appropriate to check for missing existing Slaves when adding new Slaves and the method suggested above is reasonable, the method by which Slaves are determined missing is not determined. If for elegance (or simplicity) purposes it is desirable that slave IDs increment in order, then when a slave is determined missing all slaves can be re-ID-ed in order. Also, because queries and responses take time, the speed of operations which require status requests is related to the number of slaves attached, so in some cases it is desirable to constantly poll for the status of slaves so that missing slaves are quickly removed from the master's slave list.

Behavior as Slave

Once an ADAT has been assigned a device id, it is a Slave and will only monitor the serial in of its Sync In port, and only transmit out its serial out of the Sync In port when responding to a received message. The Sync Out port's serial out will transmit whatever is received at the serial in of the Sync In port (Sync Out Send is a copy of Sync In Receive).

In order for Slaves to identify when they've been disconnected from the master, the sample clock on the Sync In port should be monitored. If the clock is lost for more than 2 seconds, the Master should be considered missing and Sync should cycle through its power-on reset. For this reason, the sample clock should never be stopped, even when another source is providing the clock which is actually being used by the converters as the sample clock.

Behavior as Master

Once an ADAT becomes a Master, it will transmit commands out of the Sync Out port and receive only responses (Any erroneous commands received by the Sync Out port must be ignored.). The Sync In port should be monitored for polling commands (indicating there is a new master) or MMC commands (see Section 6.4.2 below). When configured as a Master with no Slaves, commands should still be sent out the Sync Out port (see Section 6.4.2 below).

Note: Early implementations of ADAT Sync used only one serial port, which it would switch between the Sync Out and Sync In connectors. In addition, the serial in of the Sync In connector was logically OR-ed with the serial out of the Sync Out connector, and the serial in of the Sync Out connector was logically OR-ed with the serial out of the Sync In connector. Using this method, if the Master only speaks to a single slave at a time, no conflicts occur, and the Master must periodically monitor its Sync In connector for polling commands. Because the Master was required to often switch which connector the single serial port was listening to, this implementation sometimes causes missed messages by the Master. It is because of this that the Sync protocol was designed such that Slaves

will never send messages to the Master unless queried by the Master, and must respond immediately to these messages.

Resetting the Chain

When any ADAT (Master or Slave) receives a Primary Polling command, it reverts to the power-on configuration sequence. When a Master ADAT receives a Secondary or Primary Polling command, it will revert to its power-on configuration sequence.

6.4.2 MIDI and Sync

The essential transport messages used by ADAT Sync are, with the exception of Auto Record/Punch (38), all MMC messages. This allows MIDI sequencers (computer based or otherwise) as well as other non-ADAT machines which handle/send MMC to operate with an ADAT sync chain, although the results will not be sample accurate. In order for MMC to work effectively with ADATs, the following setups have been considered.

ADAT Sync chain follows MMC source

In this setup, a MIDI to Sync converter is used to send MMC commands to an ADAT chain via the Sync In port. Because the MMC source provides no ADAT Sync configuration commands or polling, the first ADAT will configure itself as the master. The master will interpret incoming commands, format them into the ADAT Sync framework which is sample accurate, to control the rest of the chain. For this configuration to work, the Sync In port must be checked for and implement MMC commands, even when the device is configured as a master. The master should ignore ADAT commands with the exception of ADAT Polling Disable (0B), which is used by some ADAT Computer Interfaces (ACIs). See below.

ADAT Sync chain is controlled by ADAT Computer Interface (ACI)

MIDI based ACIs generally have a set of MIDI In/Out ports and a set of Sync In/Out ports. The Computer MIDI sequencer sends MMC commands which are sent to the Sync Out port of the ACI and interpreted by the ADAT at the Sync In port, exactly as described above (with the Sync chain following an MMC source). The ADAT chain's Sync Out is then sent back to the ACI which takes the timecode signal only and translates this into MIDI Time Code (MTC) Quarter Frame messages. This allows the computer based sequencer to chase the ADAT transport. Typically ACIs do not request status or any other sort of feedback besides listening to ADAT timecode. Occasionally, ACIs use ADAT Sync commands to provide finishing touches on the interface:

- 1) The Polling Disable (0B) command to disable polling for slaves. These ACI's are intended for use with only a single ADAT, and use this command to prevent the ADAT from looking for slaves.
- 2) The Synchronize (08) command, which it listens for to begin translating timecode into MTC quarter frame messages.

Because of these key features, even when ADAT Sync is operating in standalone master mode it should send out timecode and sync messages in case there is an ACI or non-ADAT device connected to the Sync Out port which monitors these messages.

6.4.3 Record and Auto Record

Simple Record

Simple Record Sequence:

```
02    - MMC Play
08    - ADAT Synchronize
{[0E 00 - ADAT Poll Type 00]}
06    - MMC Record Strobe
```

Simple Record Exit Sequence:

```
07    - MMC Record Exit
-or if stopping as well-
07    - MMC Record Exit
09    - MMC Pause
```

Polling for status is optional. Because ADATs will not record data unless they are synchronized, sending the Record Strobe when ADATs may not be synchronized gives greater differences in punch in time. Although ADAT Sync ensures that all machines are playing back/recording at the same sample, it is impossible to guarantee accurate Punch In/Out times without using Auto Record. In order for ADATs to punch in at approximately the same time, machines should be queried to determine when they are synchronized before the MMC Record Strobe is issued. Similarly, the master should stay in Record Standby until all machines are synchronized if this method is used.

When no tracks are armed, sample rate does not match, song is write protected, or for any other reason a slave is unable to record, it should enter Record Standby and should un-mute and play along. If it is unable to remain synchronized for any fatal reason, the slave should respond to status queries with NO TAPE so that the master does not remain in Record Standby.

When a slave loses synchronization, it should exit record. The master, if polling for status, may optionally act upon (for example, stop the record on all slaves) a slave losing synchronization while recording. Currently, ADATs losing synchronization while recording exit record and stop, however the master does not stop the rest of the chain and the record session will continue.

MMC only machines will work with simple record.

Auto Record (Auto Punch)

Auto Record Sequence:

```
37 15 - Set Locate Point Punch In
37 16 - Set Locate Point Punch Out
02    - MMC Play
08    - ADAT Synchronize
{[0E 00 - ADAT Poll Type 00]}
38 01 - ADAT Auto Record Enable
-at Punch In point-
06    - MMC Record Strobe
-just after Punch Out point or if Record is aborted at any time-
07    - MMC Record Exit
38 00 - ADAT Auto Record Disable
```

Usage Notes: MMC Record Strobe (06) is ignored by ADATs, however, this command is required to provide MMC compatibility, similarly, if the Auto Record completes normally, the MMC Record Exit (07) is also required for compatibility. If the Record is cancelled at any time either before the Punch In point or after, both the MMC Record Exit and ADAT Auto Record Disable must be issued.

All other notes from Simple Record apply, with the addition that if the Punch In/Out Locate points are invalid for any reason, the ADAT should not enter Auto Record and should stay in Record Standby.

It is vital that ADAT Auto Record Disable is sent whenever the Auto Record is finished or exited. See Section 6.4.4 on Looping and Deferred Play below.

MMC only machines should work roughly with Auto Record as long as MMC Record Strobe/Exit are sent approximately at the Punch In/Out times.

6.4.4 Looping and Deferred Play/Record

There are many differences between ADAT machines concerning the handling of Looping, Deferred Play, Deferred Record and how Auto Recording is handled in all situations. Please refer to Section 6.5 Deviant Behavior below for details on how existing ADAT machines handle these instances.

Looping

The master machine completely handles all looping, which on ADAT machines is configured using Auto Play and Auto Return as well as Loop Start/End points. The ADAT Auto Play (23) and Auto Return (22) are display only commands. When a slave receives one of these commands, it does NOT enable Auto Return/Play, but instead turns on/off any display indicators for these functions. The commands are used only so that ADATs have uniform displays.

Simple Looping:

```
22 7F - ADAT Indicate Auto Return Enable
23 7F - ADAT Indicate Auto Play Enable
02    - MMC Play
08    - ADAT Synchronize
-when Auto Return point is reached on the master-
01    - MMC Stop
16 03 - ADAT Locate to included timecode
{[42 1 48 - MMC Tally Poll]}
-All slaves have finished locating-
22 7F - ADAT Indicate Auto Return Enable
23 7F - ADAT Indicate Auto Play Enable
02    - MMC Play
etc...
```


Deferred Play and Deferred Record

See MMC Deferred Play (03). Old implementations of Deferred Play are explained here, however, to avoid conflict with the MMC RP document, new implementations of Deferred Play should be as follows:

New Implementations:

- User presses Locate on master unit-
- 16 03 - ADAT Locate to included timecode
- {[42 1 48 - MMC Tally Poll]}
- User presses Play on master unit-
- All slaves have finished locating-
- 02 - MMC Play
- 08 - ADAT Synchronize

Note that in new implementations, no information about the next transport command is given to slaves. Only the master is aware that a play is pending. Deferred Record follows from the above example.

Old Implementations of Deferred Play:

- User presses Locate on master unit-
- 16 03 - ADAT Locate to included timecode
- {[42 1 48 - MMC Tally Poll]}
- User presses Play on master unit-
- 03 - MMC Deferred Play
- {[42 1 48 - MMC Tally Poll]}
- All slaves have finished locating-
- 02 - MMC Play
- 08 - ADAT Synchronize

Old Implementations of Deferred Record:

- User presses Locate on master unit-
- 16 03 - ADAT Locate to included timecode
- {[42 1 48 - MMC Tally Poll]}
- User presses Record on master unit-
- 06 - MMC Record Strobe
- 03 - MMC Deferred Play
- {[42 1 48 - MMC Tally Poll]}
- All slaves have finished locating-
- 02 - MMC Play
- 08 - ADAT Synchronize

Note that on old implementations of Deferred Record, when the Record Strobe is received, the only way that the slaves knows that it is receiving a Deferred Record command (rather than an immediate one) is that it receives the command while it is Locating. This only works well when machines have transports which locate at roughly the same speed and are locating to and from the same locations. This implementation is problematic for non-tape based machines, which will go into Record Standby if they've already finished locating (likely), although they won't punch in until the Synchronize command is received, avoiding unacceptable behavior. Note that old implementations do not re-issue the Record Strobe. If a Record Strobe has been received when locating, the unit should go into Record when the next Play command is received.

6.5 ADAT Sync Deviant Behavior and Notes

6.5.1 XT/LX/XT20/LX20

The XT compatible ADAT machines are the most compatible machines with both MMC and ADAT specifications. Notes on their behavior are as follows:

- 1) XT ADATs do not query for synchronization status or slave-is-alive status. They do generally query the first slave for locate pending status.
- 2) XT ADATs lose device configuration messages while powering up, although they will respond to chain configuration messages. To avoid losing messages, once the ADAT has been configured, it should be polled for status. Once it begins responding to status, device configuration (Sample Rate, Track Delay, etc) commands may be sent.
- 3) XT ADATs won't play from the front panel unless timecode messages are received every 960 sample periods exactly. When the master is idle, individual slaves should allow control from the front panel (ie PLAY), however, XT ADATs do not PLAY correctly unless the stationary timecode they are receiving is being sent every 960 sample clocks. Timecode sent every 66 to 65536 samples, as should be valid, does not work with XT ADATs.
- 4) XT ADATs send spurious messages to their Sync In port, including polling commands, even when configured as a slave.
- 5) XT ADATs send only MMC Record Strobe (06) when entering Record, followed by ADAT Synchronize (08). No MMC Play (02) is issued.

6.5.2 BRC

- 1) BRC will not issue Play command (following a Deferred Play) until it has received confirmation that all slaves have finished locating.
- 2) BRC does not issue Record Exit when in Auto-Record Standby and Stop or Play is pressed to abort the Auto Record. BRC only issues MMC Play command in this situation.
- 3) BRC does not use Auto Return (Auto 2> 1) command, so the displays of slaves will not match the BRC when looping.
- 4) BRC will unthread all slaves before performing locates of over 3 minutes, and will not send the locate command until all slaves respond with UNTHREADED or STOPPED (vs. PAUSED) to status queries.
- 5) When looping with Auto Record, the BRC will only issue a single ADAT Auto Record Enable (38) message. When the BRC reaches the Punch Out point, it does not issue an ADAT Auto Record Disable (38) message. It is expected that if an ADAT Auto Record Enable (38) message has been received, all further MMC Play (02) messages should be treated as an ADAT Auto Record Enable (38) message, until Auto Record has been disabled.
- 6) BRC only sends Punch In/Out points at the first Auto Record, or whenever the points are changed. This is problematic if these points are changed for any reason, such as by the user via the slave's front panel or if the points are reset for some other reason. The points are not updated if the BRC performs another Auto Record.

7) BRC does not take an ID. The ID of the first slave is 00.

8) BRC does not issue MMC Record Strobe (06) when located at sample 0.

6.5.3 M20

M20s use their own extension of the ADAT Sync specification. Please see the Alesis M20 System Exclusive document for details. Features implemented as part of this document causes some incompatibility with ADAT XT and HD24 slaves which adhere to the ADAT and ADAT XT Sync specifications only.

1) M20s process MMC Stop (01) message ahead of all other messages they have recently received, discarding these messages. The result is that M20s drop messages when they receive the Stop command.

2) M20s respond to ADAT Format Position Query (11) incorrectly, resulting in the inability to write setup to tape using the BRC.

3) An M20 that is offline will respond to all status queries with Stopped and its current timecode. This causes an offline M20 to work incorrectly with any master which polls for synchronization before sending a Record Strobe, namely, other M20s, BRC and HD24.

3) M20s do not correctly reconfigure Sync chains when new slaves are added, nor do M20s correctly reconfigure they chain when they detect slaves are missing.

6.5.4 PCR – PCI ADAT Sync card

1) The PCR card only sends MMC Deferred Play (03) whenever it Play is used, this is problematic, and causes ADATs that are currently locating to stop in the Deferred Play state once they have finished locating. No MMC Play (02) is ever issued.

2) The PCR card will not send an ADAT Synchronize (08) command until the ADAT responds with status Playing.

3) The PCR card constantly polls for status, and if it detects Playing or Recording, automatically issues an ADAT Synchronize (08) command.

4) The PCR card continuously sends out moving (at Play speed) timecode. When Play is selected, the PCR card resets this moving timecode to the timecode it receives when polling the slave(s) for current location.