LeapFrog Leapster music file format research

Part 1 (Structure):

Every Leapster SYN file starts with 0200.

Starting at offset 0x02 is the track table. The first value here determines how many tracks there are.

0100 = 1 track, 0200 = 2 tracks, 0300 = 3 tracks... You can probably figure out the rest from here.

However many tracks there are in this file determines how many pointers there are right after the track count value. Each pointer is an unsigned 16-Bit integer (little endian).

Here’s a breakdown of a really short sequence with just 1 track from Counting on Zero:  
(Pen dragging sound loop from the write a number minigame)

02 00 = Start of file (can be changed but does nothing. Always 0200 in unmodified songs.)

01 00 = Track count (1 in this case)

08 00 = Track pointer 1 (this is the *only* pointer here because there’s only 1 track)

00 00 = Unknown (doesn’t seem to do anything when changed. Not always 0000.)

8E 7F = Set loop count to 0x7F (127)  
89 35 = Set track instrument to instrument ID 0x35 (53)

88 56 = Set track volume to 0x56 (86)

51 08 = Press key 0x51 for 8 ticks (or something like that… I have no idea how long a Leapster “tick” is.)

00 08 = Press key 0x0 for 8 ticks (treated as silence)

53 09 = Press key 0x53 for 8 ticks

00 08 = Press key 0x0 for 8 ticks (treated as silence)

56 08 = Press key 0x56 for 8 ticks

00 08 = Press key 0x0 for 8 ticks (treated as silence)

5A 09 = Press key 0x5A for 9 ticks

00 08 = Press key 0x0 for 8 ticks (treated as silence)

51 08 = Press key 0x51 for 8 ticks

00 08 = Press key 0x0 for 8 ticks (treated as silence)

53 08 = Press key 0x53 for 8 ticks

00 09 = Press key 0x0 for 9 ticks (treated as silence)

56 08 = Press key 0x56 for 8 ticks

00 08 = Press key 0x0 for 8 ticks (treated as silence)

5A 08 = Press key 0x5A for 8 ticks

00 08 = Press key 0x0 for 8 ticks (treated as silence)

8F 00 = Go back to the start or the previous loop marker after the track ends

FF 00 = End of track

As you can probably tell, this is a really simple track. Nothing is problematic with this one because there isn’t any complicated commands… Multi-track songs are problematic though. They’re a bit too long to split up into this document, so I’ll just point out the problematic/difficult to work with commands in the next section.

Part 2 (Commands):

The “CuePt” commands (*very* problematic, almost impossible to figure out so far):

0x81 (Delays the track for an unknown amount of time)

0x82 (Delays the track for an unknown amount of time)

0x83 (Delays the track for an unknown amount of time)

0x84 (Delays the track for an unknown amount of time)

0x85 (Triggers an error string in the BIOS, so it’s probably unused "{BadCuePtUser:%d}")

The “SynCmd” commands:

0x89XX = Set track instrument. XX is the ID of the instrument.  
0x8AXX = Pitch bend, not fully documented yet. I’ve only found it in Go Diego Go! Animal Rescuer.

0x8EXX = Set loop count for the current track.

0x8F00 = Set loop point for the current track (place at the end to make the track loop back to the start)

0xFF00 = End the current track or trigger a loop

That’s all of the commands. If any byte that isn’t a command shows up after a command, it’ll get treated like a key press (pitch) with a tick count (length in whatever timing system LeapFrog used. I have no idea what it is, so I can’t exactly describe it…)