

PRE-AMBLE

The following piece of reverse engineering has been made possible by the generosity of AVPlus in Adelaide, Australia, who have kindly provided me with an XR16 to examine.

All findings are based on the use of a Behringer X-Touch running firmware 1.15 (1.03), a Behringer XR16 running firmware 1.12, and the software Behringer X-AIR-Edit Mac V 1.3. I do not claim any invention or intellectual ownership on my part, and no attempts of hacking or breaking into any of the aforementioned software has been made.

The observations below are purely educational and concern the exchange of MIDI data between the two devices.

CONVENTIONS

In this document, **Green Cells** signify Data being sent TO the X-Touch with a visible effect (i.e. turning LEDs on or off, moving faders, setting scribble strips,...). **Red Cells** signify Data being sent FROM the X-Touch as a result from human interaction (i.e turning encoders, pressing/releasing momentary buttons, moving or touching Faders,...).

ESSENTIAL HARDWARE HANDSHAKE / PING / THUMP

While there is a constant stream of data coming from the X-AIR devices, there is one pair of MIDI SysEx messages (here without starting **F0** and ending **F7**) *essential* to keep the X-Touch happy and not reporting "MIDI: No Link". Without this, no joy at all:

The X-Touch SENDS every 2 secs:

00 20 32 58 54 00

The X-Touch needs to RECEIVE at least every 7-8 secs (I go with every 6 secs which has not let me down):

00 00 66 14 00

There does not have to be a true "call and response" relationship between these messages - In my case, I have a simple QLab loop sending the required response every 6 secs and everybody is happy.

PROCESS / FINDINGS

I briefly looked at the Xctl network option before putting it into the "to-hard-basket"; it seems to be some kind or replication of the MIDI messages described in this document, but it seems to be transferred via raw I then focussed on the physical MIDI in-and outputs, and started off by examining primarily the "Xctl/MC" mode of the X-Touch, as the prospect of being able to easily move between controlling two completely separate softwares with total recall was indeed enticing. However, in the course of the process, I noticed that quite a few controls seemed dead in both directions (from the physical MIDI ports' view) when using either "Xctl/MC" or "Xctl/HUI", most notably

- * parts of the TIMECODE display,
- * the entire TRANSPORT section,
- * the NAVIGATION section, and finally
- * the JOG DIAL WHEEL

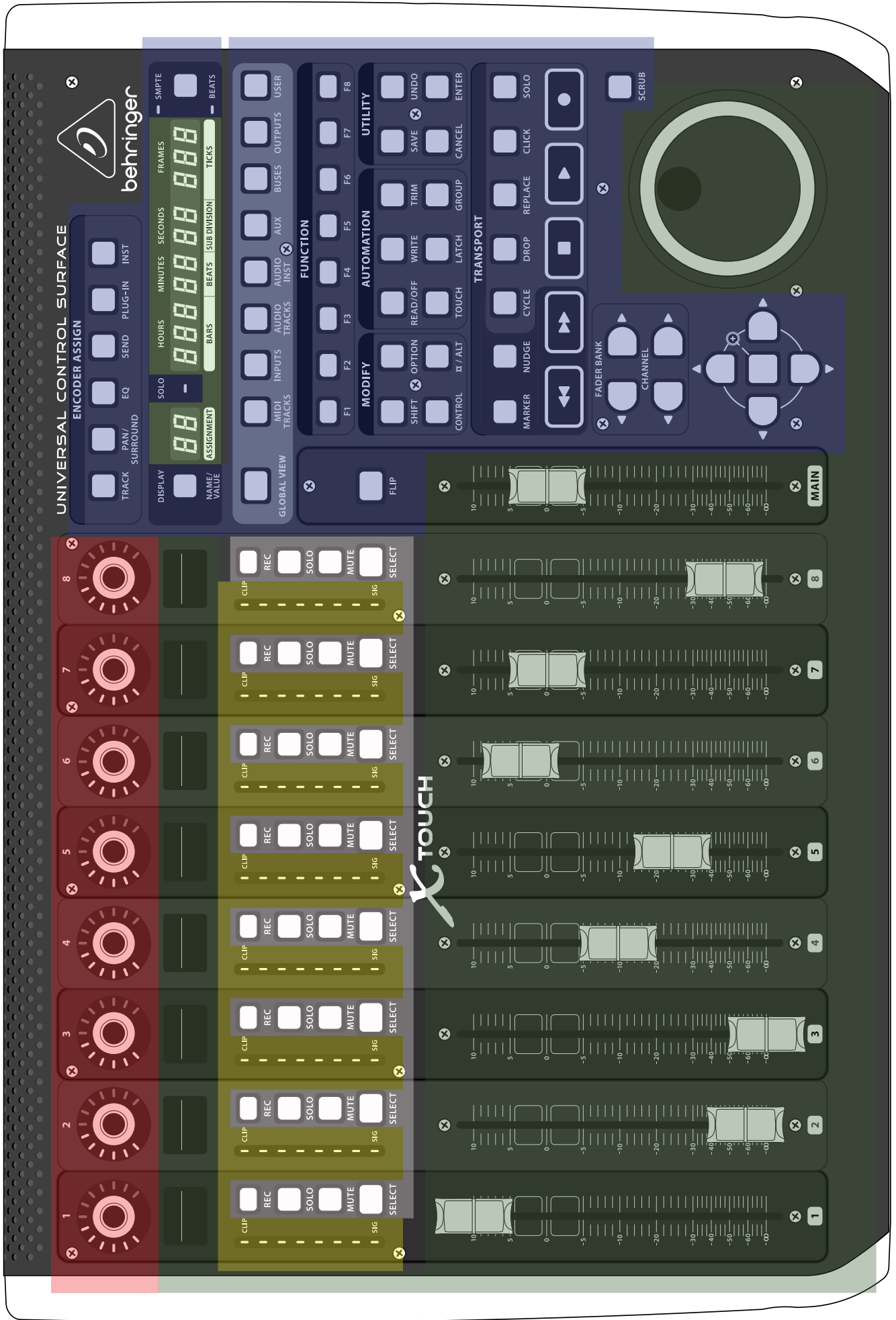
I then noted that these controls STAY ASSIGNED to the MC/HUI side of things (and their connection, in my case the "X-Touch INT" Core MIDI port via the X-Touch USB), no matter whether you are in Xctl or in MC/HUI (via the SMPTE/BEATS toggle switch). That means, if you hook up BOTH physical MIDI ports AND the USB MIDI, then you are able to use those controls exactly as described in this document (except for the timecode display that might be slightly different from Xctl to MC/HUI - at the moment, I cannot be bothered, but might update this document at a later date with more information about this).

For the moment, wherever you see ***1**, know that is part of this set of controls that stays with the MC/HUI side when in hybrid mode; if you need to access it via physical MIDI ports, you might need to stick with the "pure" Xctl protocol in the X-Touch.

Always interested in feedback or recommendations, find me on the Behringer / Music Group's forum.

Live long and prosper, care and share,

FK



All of these controls follow the same Principles as marked out below, exceptions noted here:

*1: Only through the physical MIDI ports in "pure" Xctl Mode
(not in Xctl/MC or XctlHUI)

*2: LEDs without button action

*3: Buttons without LED action

LED action		Momentary Button action				
<Control name(s) on X-Touch>		<Control name(s) on X-Touch>				
NOTE <MIDI Note>		NOTE <MIDI Note>				
MIDI Val	OFF	<Colour of LED> FLASHING	<Colour of LED> SOLID	MIDI Val	PRESS	RELEASE
0	Note On			0		Note Off
1		Note On		127	Note On	
2-127			Note On			

FADER Section (Ch 1 - 8 + MAIN)			
Control name(s) on X-Touch	MIDI Note (Range)	Colour of LED	Notes
REC aka CLIP	(0 - 7)	RED	
SOLO	(8 - 15)	ORANGE	
MUTE	(16 - 23)	RED	
SELECT aka SIG	(24 - 31)	GREEN	
FLIP (above MAIN FADER)	50	ORANGE	
ENCODER ASSIGN Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
TRACK	40	ORANGE	
PAN/SURROUND	42	ORANGE	
EQ	44	ORANGE	
SEND	41	ORANGE	
PLUG-IN	43	ORANGE	
INST	45	ORANGE	
TIMECODE DISPLAY Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
DISPLAY aka NAME/VALUE	52		*3
SOLO	115	ORANGE	*2
SMPTE (LED)	113	RED	*1, *2
SMPTE / BEATS (Button)	53		*1, *3
BEATS (LED)	114	RED	*1, *2
VIEW Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
GLOBAL VIEW	51	ORANGE	
MIDI TRACKS	62	ORANGE	
INPUTS	63	ORANGE	
AUDIO TRACKS	64	ORANGE	
AUDIO INST	65	ORANGE	
AUX	66	ORANGE	
BUSES	67	ORANGE	
OUTPUTS	68	ORANGE	
USER	69	ORANGE	
FUNCTION Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
F1	54	ORANGE	
F2	55	ORANGE	
F3	56	ORANGE	
F4	57	ORANGE	
F5	58	ORANGE	
F6	59	ORANGE	
F7	60	ORANGE	
F8	61	ORANGE	
MODIFY Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
SHIFT	70	ORANGE	
OPTION	71	ORANGE	
CONTROL	72	ORANGE	
⌘ / ALT	73	ORANGE	

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LED action		Momentary Button action				
<Control name(s) on X-Touch>		<Control name(s) on X-Touch>				
NOTE <MIDI Note>		NOTE <MIDI Note>				
MIDI Val	OFF	<Colour of LED> FLASHING	<Colour of LED> SOLID	MIDI Val	PRESS	RELEASE
0	Note On			0		Note Off
1		Note On		127	Note On	
2-127			Note On			

AUTOMATION Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
READ/OFF	74	GREEN	
WRITE	75	RED	
TRIM	76	ORANGE	
TOUCH	77	ORANGE	
LATCH	78	ORANGE	
GROUP	79	GREEN	
UTILITY Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
SAVE	80	RED	
UNDO	81	GREEN	
CANCEL	82	ORANGE	
ENTER	83	ORANGE	
TRANSPORT Section *1			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
MARKER	84	GREEN	*1
NUDGE	85	GREEN	*1
CYCLE	86	GREEN	*1
DROP	87	RED	*1
REPLACE	88	RED	*1
CLICK	89	GREEN	*1
SOLO	90	ORANGE	*1
◀◀ (REW)	91	ORANGE	*1
▶▶ (FF)	92	ORANGE	*1
■ (STOP)	93	ORANGE	*1
▶ (PLAY)	94	GREEN	*1
● (RECORD)	95	RED	*1
PAGE Section			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
FADER BANK ◀	46	ORANGE	
FADER BANK ▶	47	ORANGE	
CHANNEL ◀	48	ORANGE	
CHANNEL ▶	49	ORANGE	
NAVIGATION Section *1			
Control name(s) on X-Touch	MIDI Note	Colour of LED	Notes
▲ (UP)	96	ORANGE	*1
◀ (LEFT)	98	ORANGE	*1
⊕ (ZOOM)	100	BLUE	*1
▶ (RIGHT)	99	ORANGE	*1
▼ (DOWN)	97	ORANGE	*1
SCRUB	101	RED	*1

MIDI	LED Ring action (Ch 1 - 8)												
	CC 48 - 55							CC 56 - 63					
	Val	L6	L5	L4	L3	L2	L1	C	R1	R2	R3	R4	R5
0													
1	x							x					
2		x							x				
3	x	x						x	x				
4			x							x			
5	x		x					x		x			
6		x	x						x	x			
7	x	x	x					x	x	x			
8				x							x		
9	x			x				x			x		
10		x		x					x		x		
11	x	x		x				x	x		x		
12			x	x						x	x		
13	x		x	x				x		x	x		
14		x	x	x					x	x	x		
15	x	x	x	x				x	x	x	x		
16					x							x	
17	x				x			x				x	
18		x			x				x			x	
19	x	x			x			x	x			x	
20			x		x					x		x	
21	x		x		x			x		x		x	
22		x	x		x				x	x		x	
23	x	x	x		x			x	x	x		x	
24				x	x						x	x	
25	x			x	x			x			x	x	
26		x		x	x				x		x	x	
27	x	x		x	x			x	x		x	x	
28			x	x	x					x	x	x	
29	x		x	x	x			x		x	x	x	
30		x	x	x	x				x	x	x	x	
31	x	x	x	x	x			x	x	x	x	x	
32						x							x
33	x					x		x					x
34		x				x			x				x
35	x	x				x		x	x				x
36			x			x				x			x
37	x		x			x		x		x			x
38		x	x			x			x	x			x
39	x	x	x			x		x	x	x			x
40				x		x					x		x
41	x			x		x		x			x		x
42		x		x		x			x		x		x
43	x	x		x		x		x	x		x		x
44			x	x		x				x	x		x
45	x		x	x		x		x		x	x		x
46		x	x	x		x			x	x	x		x
47	x	x	x	x		x		x	x	x	x		x
48					x	x						x	x
49	x				x	x		x				x	x
50		x			x	x			x			x	x
51	x	x			x	x		x	x			x	x
52			x		x	x				x		x	x
53	x		x		x	x		x		x		x	x
54		x	x		x	x			x	x		x	x
55	x	x	x		x	x		x	x	x		x	x
56				x	x	x					x	x	x
57	x			x	x	x		x			x	x	x
58		x		x	x	x			x		x	x	x
59	x	x		x	x	x		x	x		x	x	x
60			x	x	x	x				x	x	x	x
61	x		x	x	x	x		x		x	x	x	x
62		x	x	x	x	x			x	x	x	x	x
63	x	x	x	x	x	x		x	x	x	x	x	x

MIDI Val		Encoder action			
		Button		Knob	
		NOTE 32 - 39		CC 16-23	
		PRESS	REL	CCW	CW
0			N/Off		
1					x
65				x	
127		N/On			

All of these controls follow the same Principles as marked out below, exceptions noted here:

*1: Only through the physical MIDI ports in

"pure" Xctl Mode (*not* in Xctl/MC or XctlHUI)

SCRIBBLE STRIP Section (Ch 1 - 8)								
All these MIDI SysEx messages below are omitting the (required) starting F0 and ending F7								
The Example below sets Scribble strip 1 to become red, with the first line displaying a centred "Ch 1" with bright font on dark background, and the second line displaying a manually right aligned "aB3" in dark font on bright background.								
MIDI SysEx Parts	Header	Channel (20 - 27)	Colour (*see below) (01-07 and 41 - 47)	Content Line 1: 7 ASCII bytes, 00 cause centreing	Content Line 2: 7 ASCII bytes, 20 works as non-breakable space			
Hex	00 00 66 58	20	41	43 68 20 31 00 00 00	20 20 20 20 61 42 33			
ASCII	N/A	N/A	N/A	Ch 1	aB3			
*Scribble Strips Color Ref "Full"								
Hex Val	00, 08, 10, 18, .., 38	01, 09, 11,..39	02, 0A, ..	03, 0B, ..	04, 0C, ..	05, 0D, ..	06, 0E, ..	07, 0F, ..
Line 1		Ch 1	Ch 1	Ch 1	Ch 1	Ch 1	Ch 1	Ch 1
Line 2		aB3	aB3	aB3	aB3	aB3	aB3	aB3
Effect	Display OFF	Red	Green	Yellow	Blue	Pink	Cyan	White
*Scribble Strips Color Ref "second line inverted"								
Hex Val	40, 48, 50, 58, .., 78	41, 49, 51,..79	42, 4A, ..	43, 4B, ..	44, 4C, ..	45, 4D, ..	46, 4E, ..	47, 4F, ..
Line 1		Ch 1	Ch 1	Ch 1	Ch 1	Ch 1	Ch 1	Ch 1
Line 2		aB3	aB3	aB3	aB3	aB3	aB3	aB3
Effect	Display OFF	Red	Green	Yellow	Blue	Pink	Cyan	White

FADER Section (Ch 1 - 8 + MAIN)										
MIDI Val	Setting Motor Pitch Bend			MIDI Val	Moving / Transmitting Pitch Bend			MIDI Val	Touching / "Z"	
	MIDI Ch 1 - 9				MIDI Ch 1 - 9				NOTE 104 - 112	
	-inf dB	0 dB	+10dB		-inf dB	0 dB	+10dB		TOUCH	RELEASE
-8192	x			-8192	x			0	Note Off	
4396		x		4396		x		127	Note On	
8191			x	8191			x			

WHEEL *1			
Encoder action *1			
MIDI	Knob		
Val	CC 60		
	CCW	CW	
1		x	
65	x		

MIDI	LCD 7 part digit						
Val	8	8	8	8	8	8	8
0							
1	x						
2		x					
3	x	x					
4			x				
5	x		x				
6		x	x				
7	x	x	x				
8				x			
9	x			x			
10		x		x			
11	x	x		x			
12			x	x			
13	x		x	x			
14		x	x	x			
15	x	x	x	x			
16					x		
17	x				x		
18		x			x		
19	x	x			x		
20			x		x		
21	x		x		x		
22		x	x		x		
23	x	x	x		x		
24				x	x		
25	x			x	x		
26		x		x	x		
27	x	x		x	x		
28			x	x	x		
29	x		x	x	x		
30		x	x	x	x		
31	x	x	x	x	x		
32						x	
33	x					x	
34		x				x	
35	x	x				x	
36			x			x	
37	x		x			x	
38		x	x			x	
39	x	x	x			x	
40				x		x	
41	x			x		x	
42		x		x		x	
43	x	x		x		x	
44			x	x		x	
45	x		x	x		x	
46		x	x	x		x	
47	x	x	x	x		x	
48					x	x	
49	x				x	x	
50		x			x	x	
51	x	x			x	x	
52			x		x	x	
53	x		x		x	x	
54		x	x		x	x	
55	x	x	x		x	x	
56				x	x	x	
57	x			x	x	x	
58		x		x	x	x	
59	x	x		x	x	x	
60			x	x	x	x	
61	x		x	x	x	x	
62		x	x	x	x	x	
63	x	x	x	x	x	x	

All of these LCD digits follow the same Principles as marked out on the left. Each digit can be with a decimal point in bottom right corner (different MIDI CC). Exception noted below:

***1:** Only through the physical MIDI ports in "pure" Xctl Mode (*not* in Xctl/MC or XctlHUI)

ASSIGNMENT Section			
Digit position on X-Touch	MIDI CC (no decimal)	MIDI CC (w/ decimal)	Notes
Left digit	96	112	
Right digit	97	113	
BARS aka HOURS Section *1			
Digit position on X-Touch	MIDI CC (no decimal)	MIDI CC (w/ decimal)	Notes
Left digit	98	114	*1
Middle digit	99	115	*1
Right digit	100	116	*1
BEATS aka MINUTES Section *1			
Digit position on X-Touch	MIDI CC (no decimal)	MIDI CC (w/ decimal)	Notes
Left digit	101	117	*1
Right digit	102	118	*1
SUB DIVISION aka SECONDS Section *1			
Digit position on X-Touch	MIDI CC (no decimal)	MIDI CC (w/ decimal)	Notes
Left digit	103	119	*1
Right digit	104	120	*1
TICKS aka FRAMES Section *1			
Digit position on X-Touch	MIDI CC (no decimal)	MIDI CC (w/ decimal)	Notes
Left digit	105	121	*1
Middle digit	106	122	*1
Right digit	107	123	*1

MIDI	LCD 7 part digit						
	Val	8	8	8	8	8	8
64							x
65	x						x
66		x					x
67	x	x					x
68			x				x
69	x		x				x
70		x	x				x
71	x	x	x				x
72				x			x
73	x			x			x
74		x		x			x
75	x	x		x			x
76			x	x			x
77	x		x	x			x
78		x	x	x			x
79	x	x	x	x			x
80					x		x
81	x				x		x
82		x			x		x
83	x	x			x		x
84			x		x		x
85	x		x		x		x
86		x	x		x		x
87	x	x	x		x		x
88				x	x		x
89	x			x	x		x
90		x		x	x		x
91	x	x		x	x		x
92			x	x	x		x
93	x		x	x	x		x
94		x	x	x	x		x
95	x	x	x	x	x		x
96						x	x
97	x					x	x
98		x				x	x
99	x	x				x	x
100			x			x	x
101	x		x			x	x
102		x	x			x	x
103	x	x	x			x	x
104				x		x	x
105	x			x		x	x
106		x		x		x	x
107	x	x		x		x	x
108			x	x		x	x
109	x		x	x		x	x
110		x	x	x		x	x
111	x	x	x	x		x	x
112					x	x	x
113	x				x	x	x
114		x			x	x	x
115	x	x			x	x	x
116			x		x	x	x
117	x		x		x	x	x
118		x	x		x	x	x
119	x	x	x		x	x	x
120				x	x	x	x
121	x			x	x	x	x
122		x		x	x	x	x
123	x	x		x	x	x	x
124			x	x	x	x	x
125	x		x	x	x	x	x
126		x	x	x	x	x	x
127	x	x	x	x	x	x	x

All of these LCD digits follow the same Principles as marked out on the left. Each digit can be with a decimal point in bottom right corner (different MIDI CC).

The Channel metering bars in each of the 8 Channel strips is designed to decay very fast automatically, and does receive peak levels only. If there is silence in the system, the X-AIR Mixers will still shoot a re-assuring zero almost precisely every 0.06 seconds to all 8 meters.

After testing a stand-in loop that does the same, I can get it as slow as "only" shooting these 8 messages every 1.2 seconds without visible flicker or signs of decay. Everything happens on Channel Pressure of MIDI Channel 1, and the way to distinguish between the channels is by MIDI Value range:

MIDI Val	LED action (counted from bottom up)							
	1 GREEN	2 GREEN	3 GREEN	4 GREEN	5 ORANGE	6 ORANGE	7 ORANGE	8 RED
<Ch Offset> + 0								
<Ch Offset> + 1	x							
<Ch Offset> + 2	x	x						
<Ch Offset> + 3	x	x	x					
<Ch Offset> + 4	x	x	x	x				
<Ch Offset> + 5	x	x	x	x	x			
<Ch Offset> + 6	x	x	x	x	x	x		
<Ch Offset> + 7	x	x	x	x	x	x	x	
<Ch Offset> + 8, <Ch Offset> + (9 thru 15)	x	x	x	x	x	x	x	x

FADER Section (Ch 1 - 8)		
Metering Channel on X-Touch	MIDI Val Ch Offset	Notes
Ch 1	0	
Ch 2	16	
Ch 3	32	
Ch 4	48	
Ch 5	64	
Ch 6	80	
Ch 7	96	
Ch 8	112	