



## **APC40 COMMUNICATIONS PROTOCOL**

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## Introduction

The APC40 is a control surface for Ableton Live software. The controller can alternately be used for controlling other software applications. The means of communication will be MIDI messages over USB.

## Scope

This document describes the format of messages between the APC40 and the PC/Mac Host.

## Glossary

**Outbound:** The term “outbound” is used to describe messages sent from the PC Host to the device, i.e. from the viewpoint of the PC Host.

**Inbound:** The term “inbound” is used to describe messages sent from the device to the PC Host, i.e. from the viewpoint of the PC Host.

## General Format of MIDI System Exclusive message

The System Exclusive messages exchanged between the PC Host and the device will be of the following format:

<i>byte number</i>	<i>value</i>	<i>description</i>
1	0xF0	MIDI System exclusive message start
2	0x47	Manufacturers ID Byte
3	<DeviceID>	System Exclusive Device ID
4	0x73	Product model ID
5	<Message ID>	Message type identifier
6	<DataLengthMS>	Number of data bytes to follow (most significant)
7	<DataLengthLS>	Number of data bytes to follow (least significant)
8	n data bytes	Data field – n bytes long
n+8	0xF7	MIDI System exclusive message terminator

The Manufacturer's identity field will contain the one-byte code allocated to Akai Professional, which is 0x47  
The System Exclusive Device ID is typically used to select between multiple devices connected to the same

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PC Host. In our application, we only expect one APC40 to be connected at any one time and so a value of 0x7F (broadcast) should be used (and it is unlikely that the APC40 will pay any regard to this field).

The Product model ID is intended to select between different Akai Professional devices that are connected to the PC Host to ensure that the message is only received by APC40 devices.

The Message type identifier identifies the type of the message. This field will determine the size of the data field and how the data field bytes should be interpreted.

There will be a number of data bytes in the message. Different message types are likely to have a different data field lengths/formats.

### ***Communications from PC Host to device - “Outbound” messages***

#### **“Universal” MIDI messages**

##### ***Device Enquiry***

The APC40 supports the standard MMC Device Enquiry message. These System Exclusive messages are part of the MIDI Machine Control Standard and do not follow the general format for APC40 System Exclusive messages.

##### ***Format of Device Inquiry Request message from Host to Device***

<b><i>byte number</i></b>	<b><i>value</i></b>	<b><i>Description</i></b>
1	0xF0	MIDI System exclusive message start
2	0x7E	Non-Realtime Message
3	0x00	Channel to inquire. (Set to 0 for this protocol.)
4	0x06	Inquiry Message
5	0x01	Inquiry Request
6	0xF7	MIDI System exclusive message terminator

The APC40 will respond to a Device Inquiry Request message with the following message:

##### ***Format of response from APC40 to Device Inquiry message***

<b><i>byte number</i></b>	<b><i>value</i></b>	<b><i>description</i></b>
1	0xF0	MIDI System exclusive message start

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<i>byte number</i>	<i>value</i>	<i>description</i>
2	0x7E	Non-Realtime Message
3	<MIDI Channel>	Common MIDI channel setting
4	0x06	Inquiry Message
5	0x02	Inquiry Response
6	0x47	Manufacturers ID Byte
7	0x73	Product model ID
8	0x00	Number of data bytes to follow (most significant)
9	0x19	Number of data bytes to follow (least significant)
10	<Version1>	Software version major most significant
11	<Version2>	Software version major least significant
12	<Version3>	Software version minor most significant
13	<Version4>	Software version minor least significant
14	<DeviceID>	System Exclusive Device ID
15	<Serial1>	Serial Number first digit
16	<Serial2>	Serial Number second digit
17	<Serial3>	Serial Number third digit
18	<Serial4>	Serial Number fourth digit
19	<Manufacturing1>	Manufacturing Data byte 1
20	<Manufacturing2>	Manufacturing Data byte 2
21	<Manufacturing3>	Manufacturing Data byte 3
22	<Manufacturing4>	Manufacturing Data byte 4
23	<Manufacturing5>	Manufacturing Data byte 5
24	<Manufacturing6>	Manufacturing Data byte 6
25	<Manufacturing7>	Manufacturing Data byte 7
26	<Manufacturing8>	Manufacturing Data byte 8
27	<Manufacturing9>	Manufacturing Data byte 9

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<i>byte number</i>	<i>value</i>	<i>description</i>
28	<Manufacturing10>	Manufacturing Data byte 10
29	<Manufacturing11>	Manufacturing Data byte 11
30	<Manufacturing12>	Manufacturing Data byte 12
31	<Manufacturing13>	Manufacturing Data byte 13
32	<Manufacturing14>	Manufacturing Data byte 14
33	<Manufacturing15>	Manufacturing Data byte 15
34	<Manufacturing16>	Manufacturing Data byte 16
35	0xF7	MIDI System exclusive message terminator

## Outbound APC40 Sysex Message Types

There will be three types of message from the PC host to the device.

### ***Outbound Message Type 0: Introduction***

This message is sent before any other device-specific message (i.e. other than Device Enquiry). It instructs the APC40 to perform the necessary initialization and informs the firmware of the version number of the application in order that changes in the application can be catered for in the APC40 firmware.

There are three modes that are accepted. The unit defaults to Mode 0 on startup.

<b>Mode</b>	<b>Identifier</b>	<b>Name</b>
0	0x40	Generic Mode
1	0x41	Ableton Live Mode
2	0x42	Alternate Ableton Live Mode

Notes Regarding Generic Mode (Mode 0):

- [CLIP LAUNCH] buttons are momentary and should light the green LED when ON
- [CLIP STOP] buttons are momentary and should light its LED when ON
- [ACTIVATOR], [SOLO], [RECORD ARM] are toggle buttons and should light its LED when ON
- [TRACK SELECTION] buttons (1-8 + MASTER) are radio style and only one of the 9 buttons are ON at a time. When ON its LED should light. These buttons will NOT send out MIDI in generic mode for its state. These buttons dictate which one of nine banks the DEVICE CONTROL knobs and DEVICE CONTROL switches belong to. These knobs and switches will output on a different MIDI channel based on the current Track Selection (track 1 = MIDI channel 0, track 8 = MIDI channel 7, MASTER = MIDI channel 8). Upon pressing one of the Track Selection buttons, the current position of the 8

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Device Control knobs will be sent.

- [CLIP/TRACK (1)], [DEVICE ON/OFF (2)], [← (3)], [→ (4)] will be toggle style and will light its LED when ON
- [DETAIL VIEW (5)], [REC QUANTIZATION (6)], [MIDI OVERDUB (7)], [METRONOME (8)] will be momentary style and will light its LED when ON
- [SCENE LAUNCH] and [STOP ALL CLIPS] buttons are momentary buttons and will light its LED when ON
- TRACK CONTROL buttons are toggle buttons and will light its LED when ON
- TRACK CONTROL KNOBS and buttons are NOT banked in any way
- [PLAY], [STOP], [RECORD], [UP], [DOWN], [LEFT], [RIGHT], [SHIFT], [NUDGE+], [NUDGE-], [TAP TEMPO] are momentary buttons
- LED rings are all set to SINGLE style

Notes Regarding Ableton Live Mode (Mode 1):

- All buttons are momentary buttons
- Device control knobs and buttons are not banked within the APC40
- LED Rings around the knobs are controlled by the APC40 but can be updated by the Host
- All other LEDs are controlled by the Host

Notes Regarding Alternate Ableton Live Mode (Mode 2):

- All buttons are momentary buttons
- Device control knobs and buttons are not banked within the APC40
- All LEDs are controlled by the Host

### *Format of Type 0 outbound message*

<b><i>byte number</i></b>	<b><i>value</i></b>	<b><i>description</i></b>
1	0xF0	MIDI System exclusive message start
2	0x47	Manufacturers ID Byte
3	<DeviceID>	System Exclusive Device ID
4	0x73	Product model ID
5	0x60	Message type identifier
6	0x00	Number of data bytes to follow (most significant)
7	0x04	Number of data bytes to follow (least significant)

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<i>byte number</i>	<i>value</i>	<i>description</i>
8	0x40 or 0x41 or 0x42	Application/Configuration identifier
9	<Version High>	PC application Software version major
10	<Version Low>	PC application Software version minor
11	<Bugfix Level>	PC Application Software bug-fix level
12	0xF7	MIDI System exclusive message terminator

### ***Outbound Message Type 1: LEDs.***

This message is used to control the states of the LEDs. A note-on message will cause the specified LED to switch on. A note-off message will cause the specified LED to switch off. The field normally associated with note number will be used to specify the LED. The field normally associated with velocity will indicate the LED display type. The field normally associated with MIDI Channel will indicate the Track for certain LEDs. A Note On message with a velocity of zero is equivalent to a Note Off message, however it is preferred that an actual Note Off message is used.

#### ***Format of Type 1 outbound MIDI note-on messages***

<i>byte number</i>	<i>value</i>	<i>description</i>
1	0x9<chan>	MIDI Note-on. The 4-bit <chan> value will be used for the track strips
2	<ControlID>	identifier for LED object ("note number")
3	state	control value (This value will describe the state or color of the LED: OFF/ON/blinking, etc)

#### ***Format of Type 1 outbound MIDI note-off messages***

<i>byte number</i>	<i>value</i>	<i>description</i>
1	0x8<chan>	MIDI Note-off. The 4-bit <chan> value will be used for the track strips
2	<ControlID>	identifier for LED object ("note number")
3	(unused)	control value (ignored)



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*Assignment of Note number messages to LEDs. Note 0x30 to 0x39 use MIDI Channel 0 to 7 to indicate Tracks 1-8. All other note values ignore the MIDI Channel.*

<b>note number</b>	<b>MIDI Channel</b>	<b>corresponding LED</b>	<b>Velocity</b>
0x30 (C_3)	0-7 = Track 1-8	RECORD ARM	0=off, 1-127=on
0x31 (C#3)	0-7 = Track 1-8	SOLO	0=off, 1-127=on
0x32 (D_3)	0-7 = Track 1-8	ACTIVATOR	0=off, 1-127=on
0x33 (D#3)	0-7 = Track 1-8	TRACK SELECTION	0=off, 1-127=on
0x34 (E_3)	0-7 = Track 1-8	CLIP STOP	0=off, 1=on, 2=blink, 3-127=on
0x35 (F_3)	0-7 = Track 1-8	CLIP LAUNCH 1	0=off, 1=green, 2=green blink, 3=red, 4=red blink, 5=yellow, 6=yellow blink, 7-127=green
0x36 (F#3)	0-7 = Track 1-8	CLIP LAUNCH 2	0=off, 1=green, 2=green blink, 3=red, 4=red blink, 5=yellow, 6=yellow blink, 7-127=green
0x37 (G_3)	0-7 = Track 1-8	CLIP LAUNCH 3	0=off, 1=green, 2=green blink, 3=red, 4=red blink, 5=yellow, 6=yellow blink, 7-127=green
0x38 (G#3)	0-7 = Track 1-8	CLIP LAUNCH 4	0=off, 1=green, 2=green blink, 3=red, 4=red blink, 5=yellow, 6=yellow blink, 7-127=green
0x39 (A_3)	0-7 = Track 1-8	CLIP LAUNCH 5	0=off, 1=green, 2=green blink, 3=red, 4=red blink, 5=yellow, 6=yellow blink, 7-127=green
0x3A (A#3)	0-8 = Track 1-8, MASTER (mode 0 only)	CLIP/TRACK (1)	0=off, 1-127=on
0x3B (B_3)	0-8 = Track 1-8, MASTER (mode 0 only)	DEVICE ON/OFF (2)	0=off, 1-127=on
0x3C (C_4)	0-8 = Track 1-8, MASTER (mode 0 only)	← (3)	0=off, 1-127=on
0x3D (C#4)	0-8 = Track 1-8, MASTER (mode 0 only)	➔ (4)	0=off, 1-127=on
0x3E (D_4)	0-8 = Track 1-8, MASTER (mode 0 only)	DETAIL VIEW (5)	0=off, 1-127=on
0x3F (D#4)	0-8 = Track 1-8, MASTER (mode 0 only)	REC QUANT (6)	0=off, 1-127=on
0x40 (E_4)	0-8 = Track 1-8, MASTER (mode 0 only)	MIDI OVERDUB (7)	0=off, 1-127=on
0x41 (F_4)	0-8 = Track 1-8, MASTER (mode 0 only)	METRONOME (8)	0=off, 1-127=on

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<i>note number</i>	<i>MIDI Channel</i>	<i>corresponding LED</i>	<i>Velocity</i>
0x50 (G#5)		MASTER	0=off, 1-127=on
0x52 (A#5)		SCENE LAUNCH 1	0=off, 1=on, 2=blink, 3-127=on
0x53 (B_5)		SCENE LAUNCH 2	0=off, 1=on, 2=blink, 3-127=on
0x54 (C_6)		SCENE LAUNCH 3	0=off, 1=on, 2=blink, 3-127=on
0x55 (C#7)		SCENE LAUNCH 4	0=off, 1=on, 2=blink, 3-127=on
0x56 (D_7)		SCENE LAUNCH 5	0=off, 1=on, 2=blink, 3-127=on
0x57 (D#7)		PAN	0=off, 1-127=on
0x58 (E_7)		SEND A	0=off, 1-127=on
0x59 (F_7)		SEND B	0=off, 1-127=on
0x5A (F#_7)		SEND C	0=off, 1-127=on

### ***Outbound Message Type 2: Controller Value Update messages***

Controls that report an absolute value for their position for inbound messages can have their controller value updated via a Controller Value Update message. This will be done using a MIDI controller message. The field normally associated with controller number will be used to specify the Control ID. The field normally associated with controller value will be used to update the value of a controller on the APC40.

#### ***MIDI Controller message***

<i>byte number</i>	<i>value</i>	<i>description</i>
1	0xB<chan>	MIDI Controller. The 4-bit <chan> value will be used for the track strips
2	<ControlID>	identifier for control surface object
3	data	control value

#### ***Assignment of controller numbers to absolute controllers***

<i>control</i>	<i>MIDI Channel</i>	<i>control ID</i>	<i>notes</i>
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<b>control</b>	<b>MIDI Channel</b>	<b>control ID</b>	<b>notes</b>
Track Level	0-7 = Tracks 1-8	0x07	
Master Level		0x0E	
Crossfader		0x0F	
DEVICE Knob 1	0-8 = Tracks 1-8, Master (for mode 0 only)	0x10	
DEVICE Knob 2	0-8 = Tracks 1-8, Master (for mode 0 only)	0x11	
DEVICE Knob 3	0-8 = Tracks 1-8, Master (for mode 0 only)	0x12	
DEVICE Knob 4	0-8 = Tracks 1-8, Master (for mode 0 only)	0x13	
DEVICE Knob 5	0-8 = Tracks 1-8, Master (for mode 0 only)	0x14	
DEVICE Knob 6	0-8 = Tracks 1-8, Master (for mode 0 only)	0x15	
DEVICE Knob 7	0-8 = Tracks 1-8, Master (for mode 0 only)	0x16	
DEVICE Knob 8	0-8 = Tracks 1-8, Master (for mode 0 only)	0x17	
DEVICE Knob 1 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x18	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
DEVICE Knob 2 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x19	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
DEVICE Knob 3 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x1A	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
DEVICE Knob 4 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x1B	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
DEVICE Knob 5 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x1C	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
DEVICE Knob 6 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x1D	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
DEVICE Knob 7 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x1E	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single

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<i><b>control</b></i>	<i><b>MIDI Channel</b></i>	<i><b>control ID</b></i>	<i><b>notes</b></i>
DEVICE Knob 8 LED Ring Type	0-8 = Tracks 1-8, Master (for mode 0 only)	0x1F	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 1		0x30	
TRACK Knob 2		0x31	
TRACK Knob 3		0x32	
TRACK Knob 4		0x33	
TRACK Knob 5		0x34	
TRACK Knob 6		0x35	
TRACK Knob 7		0x36	
TRACK Knob 8		0x37	
TRACK Knob 1 LED Ring Type		0x38	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 2 LED Ring Type		0x39	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 3 LED Ring Type		0x3A	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 4 LED Ring Type		0x3B	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 5 LED Ring Type		0x3C	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 6 LED Ring Type		0x3D	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 7 LED Ring Type		0x3E	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single
TRACK Knob 8 LED Ring Type		0x3F	0=off, 1=Single, 2=Volume Style, 3=Pan Style, 4-127=Single

### ***Interpretation of LED Ring Types***

The LED rings will display its controller value with the LEDs based on the LED Ring Types. This LED Ring Type can be set by the Host by sending an appropriate controller value message. The “Min” and “Max” columns below will state the range of the controller value that will match the LED states as shown in the “Display” column. The “LED STATES” column below will show the state of each of the 15 LEDs going from

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left to right. A “0” indicates that the LED within the LED ring is OFF. A “1” indicates that the LED within the LED ring is ON.

### A. SINGLE

MIN	MAX	LED STATES
0	3	1000000000000000
4	8	1100000000000000
9	12	0100000000000000
13	17	0110000000000000
18	21	0010000000000000
22	25	0011000000000000
26	30	0001000000000000
31	34	0001100000000000
35	38	0000100000000000
39	43	0000110000000000
44	47	0000010000000000
48	52	0000011000000000
53	56	0000001000000000
57	60	0000001100000000
61	65	0000000100000000
66	69	0000000110000000
70	73	0000000010000000
74	78	0000000011000000
79	82	0000000001000000
83	87	0000000001100000
88	91	0000000000100000
92	95	0000000000110000
96	100	0000000000010000
101	104	0000000000011000
105	108	0000000000001000
109	113	0000000000000110
114	117	0000000000000010
118	122	0000000000000011
123	127	0000000000000001

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## B. VOLUME STYLE

MIN	MAX	LED STATES
0	0	0000000000000000
1	9	1000000000000000
10	18	1100000000000000
19	27	1110000000000000
28	36	1111000000000000
37	45	1111100000000000
46	54	1111110000000000
55	63	1111111000000000
64	71	1111111100000000
72	80	1111111110000000
81	89	1111111111000000
90	98	1111111111100000
99	107	1111111111110000
108	116	1111111111111000
117	126	1111111111111100
127	127	1111111111111111

## C. PAN STYLE

MIN	MAX	LED STATES
0	8	1111111100000000
9	17	0111111100000000
18	26	0011111100000000
27	35	0001111100000000
36	44	0000111100000000

MIN	MAX	LED STATES
45	53	000001110000000
54	62	000000110000000
63	64	000000010000000
65	73	000000011000000
74	82	000000011100000
83	91	000000011110000
92	100	000000011111000
101	109	000000011111100
110	118	000000011111110
119	127	000000011111111

### ***Communications from device to PC Host - “Inbound” messages***

These messages will be used to report control surface events from the device to the PC Host and as a response to requests from the PC host.

### **Inbound Standard MIDI Message types**

These messages will use standard MIDI messages.

Each message type will contain a Control Identifier field which will identify the control surface object to which the message pertains.

Each message type will contain a data field which may contain information about either the new value of the control surface object or how it has changed since the last report.

### ***Type NOTE1: Note-on/Note-off messages***

Some devices (such as buttons) have two states and the transitions between these states will be reported using MIDI note-on (when the button is depressed) and note-off (when the button is released). The field normally associated with note number will be used to specify the Control ID.

### ***MIDI note-on messages***

<i>byte number</i>	<i>value</i>	<i>description</i>
1	0x9<chan>	MIDI Note-on. The 4-bit <chan> value will be used for the track strips.

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<b>byte number</b>	<b>value</b>	<b>description</b>
2	<ControllID>	identifier for control surface object ("note number")
3	0x7F	control value (non-zero)

## MIDI note-off messages

<b>byte number</b>	<b>value</b>	<b>description</b>
1	0x8<chan>	MIDI Note-off. The 4-bit <chan> value will be used for the track strips
2	<ControllID>	identifier for control surface object ("note number")
3	0x7F	control value (ignored)

Assignment of note numbers to buttons. Note 0x30 to 0x49 use MIDI Channel 0 to 7 to indicate Tracks 1-8. All other note values ignore the MIDI Channel. In Mode 1 or Mode 2, all buttons act as momentary buttons.

<b>control</b>	<b>MIDI Channel</b>	<b>note number</b>	<b>Mode 0 Button Type</b>
RECORD ARM	0-7 = Track 1-8	0x30 (C_3)	Toggle
SOLO	0-7 = Track 1-8	0x31 (C#3)	Toggle
ACTIVATOR	0-7 = Track 1-8	0x32 (D_3)	Toggle
TRACK SELECTION	0-7 = Track 1-8	0x33 (D#3)	N/A
CLIP STOP	0-7 = Track 1-8	0x34 (E_3)	Momentary
CLIP LAUNCH 1	0-7 = Track 1-8	0x35 (F_3)	Momentary
CLIP LAUNCH 2	0-7 = Track 1-8	0x36 (F#3)	Momentary
CLIP LAUNCH 3	0-7 = Track 1-8	0x37 (G_3)	Momentary
CLIP LAUNCH 4	0-7 = Track 1-8	0x38 (G#3)	Momentary
CLIP LAUNCH 5	0-7 = Track 1-8	0x39 (A_3)	Momentary
CLIP/TRACK (1)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x3A (A#3)	Toggle
DEVICE ON/OFF (2)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x3B (B_3)	Toggle
← (3)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x3C (C_4)	Toggle



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<i>control</i>	<i>MIDI Channel</i>	<i>note number</i>	<i>Mode 0 Button Type</i>
→ (4)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x3D (C#4)	Toggle
DETAIL VIEW (5)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x3E (D_4)	Momentary
REC QUANT (6)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x3F (D#4)	Momentary
MIDI OVERDUB (7)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x40 (E_4)	Momentary
METRONOME (8)	0-8 = Tracks 1-8, Master (for mode 0 only)	0x41 (F_4)	Momentary
MASTER		0x50 (G#5)	N/A
STOP ALL CLIPS		0x51 (A_5)	Momentary
SCENE LAUNCH 1		0x52 (A#5)	Momentary
SCENE LAUNCH 2		0x53 (B_5)	Momentary
SCENE LAUNCH 3		0x54 (C_6)	Momentary
SCENE LAUNCH 4		0x55 (C#6)	Momentary
SCENE LAUNCH 5		0x56 (D_6)	Momentary
PAN		0x57 (D#6)	Toggle
SEND A		0x58 (E_6)	Toggle
SEND B		0x59 (F_6)	Toggle
SEND C		0x5A (F#6)	Toggle
PLAY		0x5B (G_6)	Momentary
STOP		0x5C (G#6)	Momentary
RECORD		0x5D (A_6)	Momentary
UP		0x5E (A#6)	Momentary
DOWN		0x5F (B_6)	Momentary
RIGHT		0x60 (C_7)	Momentary
LEFT		0x61 (C#7)	Momentary

## APC40 COMMUNICATIONS PROTOCOL

<i>control</i>	<i>MIDI Channel</i>	<i>note number</i>	<i>Mode 0 Button Type</i>
SHIFT		0x62 (D_7)	Momentary
TAP TEMPO		0x63 (D#7)	Momentary
NUDGE +		0x64 (E_7)	Momentary
NUDGE -		0x65 (F_7)	Momentary

### **Type CC1: Absolute Controller messages**

Most controls will report an absolute value for their position. This will be done using a MIDI controller message. The field normally associated with controller number will be used to specify the Control ID. The field normally associated with controller value will be used to report the absolute control value.

#### *MIDI Controller message*

<i>byte number</i>	<i>value</i>	<i>description</i>
1	0xB<chan>	MIDI Controller. The 4-bit <chan> value will be used for the track.
2	<ControlID>	identifier for control surface object
3	data	control value

#### *Assignment of controller numbers to absolute controllers*

<i>control</i>	<i>MIDI Channel</i>	<i>control ID</i>	<i>notes</i>
Track Level	0-7 = Tracks 1-8	0x07	
Master Level		0x0E	
Crossfader		0x0F	
DEVICE Knob 1	0-8 = Tracks 1-8, Master (for Mode 0 only)	0x10	
DEVICE Knob 2	0-8 = Tracks 1-8, Master (for Mode 0 only)	0x11	
DEVICE Knob 3	0-8 = Tracks 1-8, Master (for Mode 0 only)	0x12	
DEVICE Knob 4	0-8 = Tracks 1-8, Master (for Mode 0 only)	0x13	
DEVICE Knob 5	0-8 = Tracks 1-8, Master	0x14	

# APC40 COMMUNICATIONS PROTOCOL

<i>control</i>	<i>MIDI Channel</i>	<i>control ID</i>	<i>notes</i>
	(for Mode 0 only)		
DEVICE Knob 6	0-8 = Tracks 1-8, Master (for Mode 0 only)	0x15	
DEVICE Knob 7	0-8 = Tracks 1-8, Master (for Mode 0 only)	0x16	
DEVICE Knob 8	0-8 = Tracks 1-8, Master (for Mode 0 only)	0x17	
TRACK Knob1		0x30	
TRACK Knob 2		0x31	
TRACK Knob 3		0x32	
TRACK Knob 4		0x33	
TRACK Knob 5		0x34	
TRACK Knob 6		0x35	
TRACK Knob 7		0x36	
TRACK Knob 8		0x37	
Footswitch 1		0x40	Value of 0x7F when depressed and a value of 0x00 when released
Footswitch 2		0x43	Value of 0x7F when depressed and a value of 0x00 when released

## Type CC2: Relative Controller messages

Some controls will report a relative change in their value. This will be done using a MIDI controller message. The field normally associated with controller number will be used to specify the Control ID. The field normally associated with controller value will be used to report the change in the control value.

### MIDI Controller message

<i>byte number</i>	<i>value</i>	<i>description</i>
1	0xB<chan>	MIDI Controller. The 4-bit <chan> value will be used for the track strips

## APC40 COMMUNICATIONS PROTOCOL

<b>byte number</b>	<b>value</b>	<b>description</b>
2	<ControlID>	identifier for control surface object
3	data	control change

### *Interpretation of MIDI Controller values for Relative Controllers*

The value in the data field will indicate a relative change; values 01 to 63 describe a positive change and values 127 down to 64 describe a negative change.

<b>data value sent</b>	<b>interpretation</b>
0x00	No change occurred. Control is stationary.
0x01	The controller incremented its value by 1 since the last report
0x02	The controller incremented its value by 2 since the last report
...	...
0x3f	The controller incremented its value by 63 since the last report
0x40	The controller decremented its value by 64 since the last report
0x41	The controller decremented its value by 63 since the last report
...	...
0x7e	The controller decremented its value by 2 since the last report
0x7f	The controller decremented its value by 1 since the last report

### *Assignment of controller numbers to relative controllers*

<b>control</b>	<b>control ID</b>	<b>notes</b>
CUE LEVEL	0x2F	