ALLEN&HEATH

CQ

MIDI Protocol

Firmware V1.2 Issue 4

1. Introduction and setup

MIDI (**M**usical **I**nstrument **D**igital **I**nterface) is a standardised communication protocol that enables digital devices to communicate and allows one piece of equipment to control another.

The CQ sends and receives MIDI over USB (via the USB-B port) as well as over ethernet (using MIDI over TCP/IP via the network port).

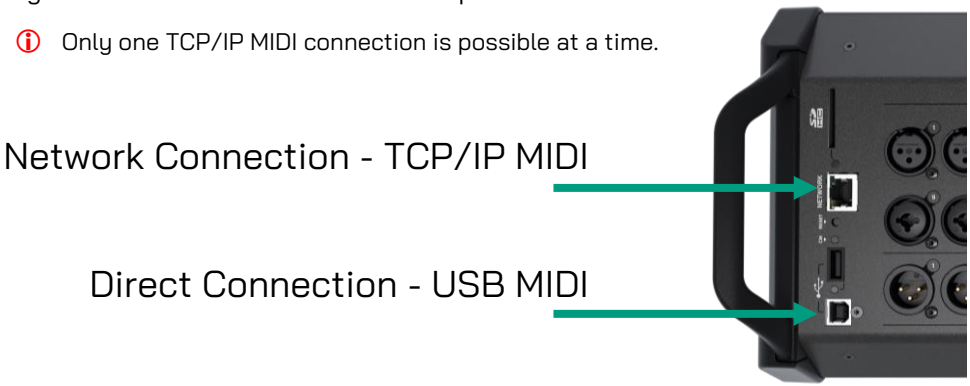
1.1 Connection

When connected to a computer using the USB-B port, the CQ will appear as a MIDI input and output device. This can be used with software directly or through use of the Allen & Heath MIDI Control application.

To connect a computer to the CQ over a network, Allen & Heath MIDI Control can be used.

All other clients used for network communication should be configured to send messages to the CQ's IP address and use port `51325`.

ⓘ Only one TCP/IP MIDI connection is possible at a time.



1.2 Transmitting and Recording

The CQ transmits MIDI messages when any changes are made on the unit (or using a connected app) to any parameters that include NRPN MIDI Control.

This means the raw MIDI output from the CQ can be recorded and then 'played back' to the CQ later to automate level and mute control.

ⓘ Avoid creating a MIDI feedback loop by sending the CQ MIDI output back to the CQ when recording MIDI data.

1.3 MIDI Channel

The MIDI standard includes 16 channels per port/device.

The CQ uses MIDI Channel 1 for all control messaging.

1.4 Types of MIDI message

MIDI messages can be presented in different ways in various hardware and software, including plain text, binary, decimal and hexadecimal.

As an example, here are four representations of the same message:

Plain text	`MIDI Channel 1, C-1, Note on`
Binary	`1001 0000 0000 0000 0111 1111`
Decimal	`144 0 127`
Hexadecimal	`0x90 0x00 0x7F`

Hexadecimal uses numbers 0-9 and letters A-F to represent 16 possible values. This document uses hexadecimal values throughout, and it should be noted that the '`0x`' prefix has been removed for brevity.

Note On/Off – The CQ uses a note on followed by a note off for MIDI triggering of the CQ SoftKeys.

CC (**C**ontinuous **C**ontroller) – For each MIDI channel there are 128 continuous controllers, each of which can have a value between 0 and 127 (128 steps). These are used by the 'CC Translator' option in the Allen & Heath MIDI Control app.

NRPN (**N**on-**R**egistered **P**arameter **N**umber) – For high-resolution control (16384 steps) and access to many more parameters, NRPN messages are used to communicate with the CQ to control levels, panning and mutes.

NRPN messages can be thought of as a specific string of CC messages, with MSB (**M**ost **S**ignificant **B**yte) and LSB (**L**east **S**ignificant **B**yte) representing a parameter number and data bytes representing parameter value.

NRPNs can be used to set the absolute value of a parameter or to increment/decrement a parameter value.

1.5 Allen & Heath MIDI Control app

The **Allen & Heath MIDI Control** app works by creating virtual MIDI ports in Mac OS or Windows and then facilitating a MIDI connection between these virtual ports and the CQ either via the USB connection or over a network via TCP/IP MIDI, and with or without translation.

This can be used to send and receive MIDI control messages directly to and from the CQ for remote control of mixing parameters, scene changes and other functions (as detailed in this document) using the 'MIDI Thru' option.

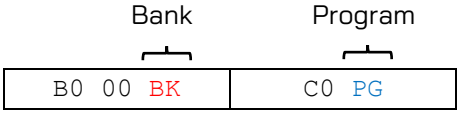
Simplified control of the most common mixing parameters using MIDI CC and Note On/Off messages from the computer is also made possible with the 'CC Translator' option.

Visit the Allen & Heath website (http://www.allen-heath.com/midi) to download the latest version of Allen & Heath MIDI Control and refer to the Help document for information on setup and configuration.

2. Available Controls

2.1 Scene change

A scene change uses a bank change followed by a program change.



Where: BK = Bank, PG = Program

The bank change (BK) may not always be required, or may only be required for the first scene change message sent to the CQ, but should be included when possible for completeness and should always be bank 1 (00).

The program change (PG) is then a value between 00 and 7F (decimal 0-127), which selects a scene in that range.

ⓘ Note that there is an offset of -1 between the CQ values and the MIDI values due to the CQ counting from 1 to 128 and MIDI counting from 0 to 127.

The scene being recalled must exist as a saved scene in the CQ, blank scenes cannot be recalled.

Examples:

Scene	Message
Scene 1	B0 00 00 C0 00
Scene 7	B0 00 00 C0 06
Scene 64	B0 00 00 C0 3F

2.2 Soft Keys

CQ Soft Keys can be controlled using standard MIDI Note On/Off messages, allowing the control of many more internal functions of the CQ by proxy.

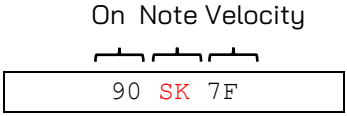
Each Soft Key is controlled with a different sequential note starting at C3 (30).

A key press is triggered with note on, and a release is triggered separately with a note off, meaning it is possible to replicate a held key.

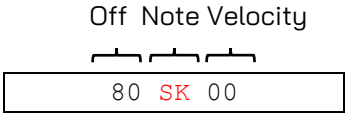
ⓘ The CQ will respond to both MIDI note off standards, i.e. a specific note off message or a note on message with zero velocity.

ⓘ The CQ does not send note on/off messages when a Soft Key is pressed.

Note On (Soft Key press)



Note Off (Soft Key release)



Both where: SK = Soft Key Note

Examples:

Soft Key	Message (Press)	Message (Release)
Soft Key #1	90 30 7F	80 30 00
Soft Key #2	90 31 7F	80 31 00
Soft Key #3	90 32 7F	80 32 00

ⓘ The HEX values shown here are accurate, but some applications and hardware use different octave designations. i.e If C3 is not controlling SoftKey 1, try C2/C4.

2.3 Mutes

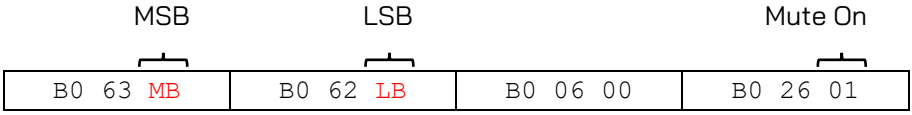
The CQ sends and receives absolute On or Off mute messages. It will also toggle the mute state when either an increment or decrement message is received.

MSB and LSB are a parameter number for the channel you wish to mute or unmute.

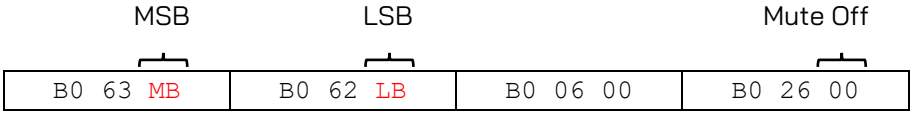
ⓘ MSB/LSB parameter numbers are shown in the reference tables section.

The last byte of the full message then represents a mute on or off.

Mute On



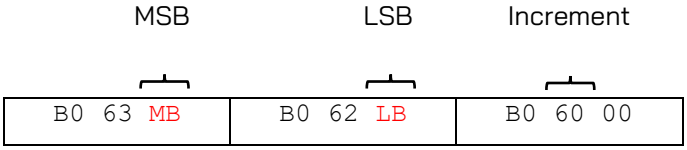
Mute Off



Both where: MB/LB = MSB/LSB Parameter number

When either a data increment or decrement message is received, the CQ will toggle between states, in the same way as pressing a mute key on the CQ does.

Mute Toggle (increment)



Where: MB/LB = MSB/LSB Parameter number

Examples:

Channel, Cmnd	Message
Ip1, Mute On	B0 63 00 B0 62 00 B0 06 00 B0 26 01
Main LR, Mute Off	B0 63 00 B0 62 44 B0 06 00 B0 26 00
Ip3, Mute Toggle	B0 63 00 B0 62 02 B0 60 00

ⓘ Mute Toggle cannot currently be used with DCA Mute and Mute Group Mute.

2.4 Levels

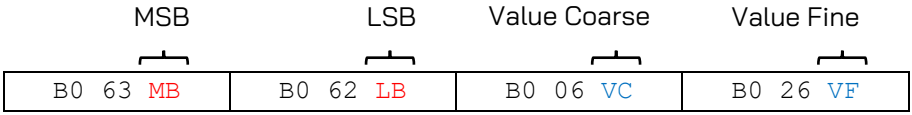
Levels can be set using either absolute values or in relative 1dB increments/decrements.

MSB and LSB are a parameter number showing where the signal is being sent from and where it is being sent to.

ⓘ MSB/LSB parameter numbers are shown in the reference tables.

Absolute Control

An absolute level is represented with a combination of course and fine values.



Where: MB/LB = MSB/LSB Parameter number, VC/VF = Value

ⓘ See 'Example Linear Taper Level Values' and 'Approximate Audio Taper Level Values' in the reference tables.

Examples:

Address, Value	Message
Ip1 to Main LR, 0dB	B0 63 40 B0 62 00 B0 06 62 B0 26 00
Ip1 to Main LR, -20dB	B0 63 40 B0 62 00 B0 06 2E B0 26 40
Ip12 to Out2, -5dB	B0 63 41 B0 62 49 B0 06 4E B0 26 40
Out 5/6 (overall), +5dB	B0 63 4F B0 62 05 B0 06 73 B0 26 40
FX2 to Out 1, -10dB	B0 63 46 B0 62 20 B0 06 3E B0 26 00
FX1 to FX2, -15dB	B0 63 4E B0 62 05 B0 06 36 B0 26 00
DCA1, -40dB	B0 63 4F B0 62 20 B0 06 0F B0 26 40

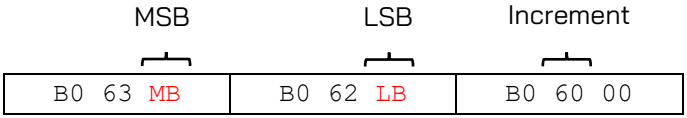
Relative Control

A relative level message uses the same parameter number, but with an increment or decrement byte.

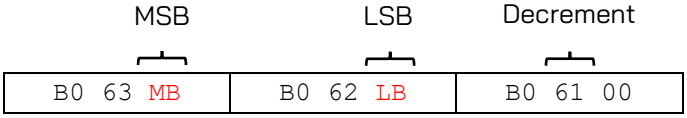
This raises or lowers a level in 1dB steps.

ⓘ The NRPN Fader Law setting has no effect on relative control.

+1dB (increment)



-1dB (decrement)



Both where: MB/LB = MSB/LSB Parameter number

Examples:

Address, Inc/Dec	Message
Ip1 to LR, Increment	B0 63 40 B0 62 00 B0 60 00
Ip1 to LR, Decrement	B0 63 40 B0 62 00 B0 61 00
FX3 to Out 3/4, Increment	B0 63 46 B0 62 2E B0 60 00

2.5 Panning/Balance

Panning (mono sources) or balance (stereo sources) can be set using either absolute values or in relative increments/decrements.

MSB and LSB represent a parameter number showing where the signal is being sent from and where it is being sent to.

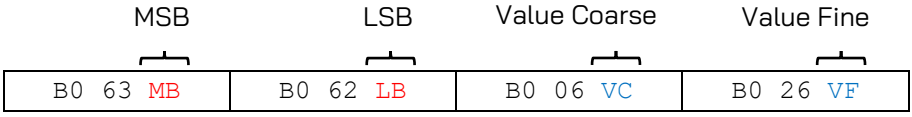
ⓘ MSB/LSB parameter numbers are shown in the reference tables.

ⓘ Note that to allow MIDI control of panning to Linked Stereo Outputs, the 'Follow Main LR Pan' setting must be set to 'Off'.

Absolute Control

Absolute values are set with a combination of coarse and fine values. Ranging from `00 00` (full left) to `7F 7F` (full right), with centre being `40 00`.

ⓘ See 'Example Pan/Balance Values' in the reference tables.



Where: `MB/LB` = MSB/LSB Parameter number, `VC/VF` = Value

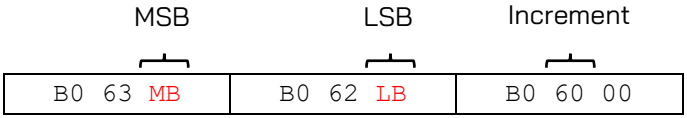
Examples:

Address, Value	Message
Ip1 to LR, L100%	B0 63 50 B0 62 00 B0 06 00 B0 26 00
Ip1 to LR, Center	B0 63 50 B0 62 00 B0 06 40 B0 26 00
Ip1 to LR, R100%	B0 63 50 B0 62 00 B0 06 7F B0 26 7F
Ip3 to Out 5/6, L30%	B0 63 50 B0 62 60 B0 06 2C B0 26 65
FX1 to Out 1/2, R10%	B0 63 56 B0 62 14 B0 06 46 B0 26 32

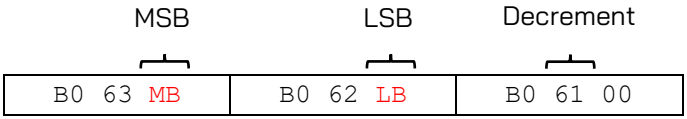
Relative Control

A relative pan/balance message uses the same parameter number, but with an increment or decrement byte. Incrementing moves to the right and decrementing moves to the left.

Right one step (increment)



Left one step (decrement)



Both where: MB/LB = MSB/LSB Parameter number

Examples:

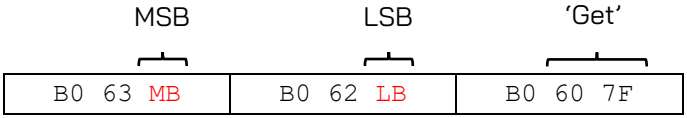
Address, Left/Right	Message
Ip1 to LR, Right	B0 63 50 B0 62 00 B0 60 00
Ip1 to LR, Left	B0 63 50 B0 62 00 B0 61 00
Ip10 to Out 1/2, Left	B0 63 51 B0 62 30 B0 61 00
BT to Out 5/6, Left	B0 63 53 B0 62 30 B0 61 00

2.6 Getting values

A 'get' command can be sent to the CQ in order to return the current value of any mute, level or pan/balance parameter listed in this document.

MSB and LSB represent the parameter number of the value being requested, followed by a data increment with value 7F (i.e. the same as a standard increment message but with a value of 7F instead of 00).

ⓘ All MSB/LSB parameter numbers are shown in the reference tables, be sure to use the correct parameter number for either mute, level, panning/balance or assignments.



Where: MB/LB = MSB/LSB Parameter number

Examples:

Parameter Requested	Message
Ip1, Mute	B0 63 00 B0 62 00 B0 60 7F
Ip1 to LR, Level	B0 63 40 B0 62 00 B0 60 7F
ST1 to Out 1/2, Pan	B0 63 52 B0 62 64 B0 60 7F
FX2 Overall Input Level	B0 63 4F B0 62 0E B0 60 7F

Decimal, HEX, Note conversion (EG and other values from 1-128)

VAL	HEX	Note
1	00	C-1
2	01	C#-1
3	02	D-1
4	03	D#-1
5	04	E-1
6	05	F-1
7	06	F#-1
8	07	G-1
9	08	G#-1
10	09	A-1
11	0A	A#-1
12	0B	B-1
13	0C	C0
14	0D	C#0
15	0E	D0
16	0F	D#0
17	10	E0
18	11	F0
19	12	F#0
20	13	G0
21	14	G#0
22	15	A0
23	16	A#0
24	17	B0
25	18	C1
26	19	C#1
27	1A	D1
28	1B	D#1
29	1C	E1
30	1D	F1
31	1E	F#1
32	1F	G1

VAL	HEX	Note
33	20	G#1
34	21	A1
35	22	A#1
36	23	B1
37	24	C2
38	25	C#2
39	26	D2
40	27	D#2
41	28	E2
42	29	F2
43	2A	F#2
44	2B	G2
45	2C	G#2
46	2D	A2
47	2E	A#2
48	2F	B2
49	30	C3
50	31	C#3
51	32	D3
52	33	D#3
53	34	E3
54	35	F3
55	36	F#3
56	37	G3
57	38	G#3
58	39	A3
59	3A	A#3
60	3B	B3
61	3C	C4
62	3D	C#4
63	3E	D4
64	3F	D#4

VAL	HEX	Note
65	40	E4
66	41	F4
67	42	F#4
68	43	G4
69	44	G#4
70	45	A4
71	46	A#4
72	47	B4
73	48	C5
74	49	C#5
75	4A	D5
76	4B	D#5
77	4C	E5
78	4D	F5
79	4E	F#5
80	4F	G5
81	50	G#5
82	51	A5
83	52	A#5
84	53	B5
85	54	C6
86	55	C#6
87	56	D6
88	57	D#6
89	58	E6
90	59	F6
91	5A	F#6
92	5B	G6
93	5C	G#6
94	5D	A6
95	5E	A#6
96	5F	B6

VAL	HEX	Note
97	60	C7
98	61	C#7
99	62	D7
100	63	D#7
101	64	E7
102	65	F7
103	66	F#7
104	67	G7
105	68	G#7
106	69	A7
107	6A	A#7
108	6B	B7
109	6C	C8
110	6D	C#8
111	6E	D8
112	6F	D#8
113	70	E8
114	71	F8
115	72	F#8
116	73	G8
117	74	G#8
118	75	A8
119	76	A#8
120	77	B8
121	78	C9
122	79	C#9
123	7A	D9
124	7B	D#9
125	7C	E9
126	7D	F9
127	7E	F#9
128	7F	G9

Soft Key Notes and Hexadecimal Values (SK)

SoftKey	Note	HEX
1	C3	30
2	C#3	31
3	D3	32

Example Level Values (VC/VF)

dB	VC	VF	dB	VC	VF	dB	VC	VF	dB	VC	VF	dB	VC	VF	dB	VC	VF
-inf	00	00	-45	0C	00	-29	20	40	-19	30	00	-9	41	40	+1	65	40
-89	01	40	-40	0F	40	-28	22	00	-18	31	40	-8	44	40	+2	69	00
-85	02	00	-38	12	40	-27	23	40	-17	33	00	-7	48	00	+3	6C	40
-80	02	40	-36	15	40	-26	25	00	-16	34	40	-6	4B	00	+4	70	00
-75	03	40	-35	17	00	-25	26	40	-15	36	00	-5	4E	40	+5	73	40
-70	04	00	-34	19	00	-24	28	40	-14	38	00	-4	52	40	+6	75	40
-65	05	00	-33	1A	40	-23	2A	00	-13	39	40	-3	56	40	+7	78	00
-60	06	00	-32	1C	00	-22	2B	40	-12	3B	00	-2	5A	00	+8	7A	40
-55	07	00	-31	1D	40	-21	2D	00	-11	3C	40	-1	5E	00	+9	7D	00
-50	08	00	-30	1F	00	-20	2E	40	-10	3E	00	0	62	00	+10	7F	40

Example Pan/Balance Values (VC/VF)

L/R	VC	VF	L/R	VC	VF	L/R	VC	VF	L/R	VC	VF	L/R	VC	VF
L100%	00	00	L50%	1F	7F	L10%	39	4B	R15%	49	4B	R60%	66	32
L90%	06	33	L40%	26	32	L5%	3C	65	R20%	4C	65	R70%	6C	65
L80%	0C	66	L30%	2C	65	CTR	40	00	R30%	53	18	R80%	73	18
L70%	13	19	L20%	33	18	R5%	43	18	R40%	59	4B	R90%	79	4B
L60%	19	4C	L15%	36	32	R10%	46	32	R50%	5F	7F	R100%	7F	7F

In the following tables, the source is shown on the left and the destination is shown at the top.

Each parameter number includes one MSB (MB) and one LSB (LB).

Mute Parameter Numbers – (MB/LB)

	MUTE	
	MSB	LSB
Ip1	00	00
Ip2	00	01
Ip3	00	02
Ip4	00	03
Ip5	00	04
Ip6	00	05
Ip7	00	06
Ip8	00	07
Ip9	00	08
Ip10	00	09
Ip11	00	0A
Ip12	00	0B
Ip13	00	0C
Ip14	00	0D
Ip15	00	0E
Ip16	00	0F

	MUTE	
	MSB	LSB
St1	00	18
St2	00	1A
USB	00	1C
BT	00	1E

	MUTE	
	MSB	LSB
FX1	00	51
FX2	00	52
FX3	00	53
FX4	00	54

	MUTE	
	MSB	LSB
Main LR	00	44

	MUTE	
	MSB	LSB
Out1	00	45
Out2	00	46
Out3	00	47
Out4	00	48
Out5	00	49
Out6	00	4A

	MUTE	
	MSB	LSB
Out1/2	00	45
Out3/4	00	47
Out5/6	00	49

	MUTE	
	MSB	LSB
MGRP1	04	00
MGRP2	04	01
MGRP3	04	02
MGRP4	04	03

	MUTE	
	MSB	LSB
DCA1	02	00
DCA2	02	01
DCA3	02	02
DCA4	02	03

Level Parameter Numbers – Inputs and FX to Outputs and FX (MB / LB)

	Main LR		Out1/2				Out3/4				Out5/6				FX1		FX2		FX3		FX4	
			Out1		Out2		Out3		Out4		Out5		Out6									
	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB
Ip1	40	00	40	44	40	45	40	46	40	47	40	48	40	49	4C	14	4C	15	4C	16	4C	17
Ip2	40	01	40	50	40	51	40	52	40	53	40	54	40	55	4C	18	4C	19	4C	1A	4C	1B
Ip3	40	02	40	5C	40	5D	40	5E	40	5F	40	60	40	61	4C	1C	4C	1D	4C	1E	4C	1F
Ip4	40	03	40	68	40	69	40	6A	40	6B	40	6C	40	6D	4C	20	4C	21	4C	22	4C	23
Ip5	40	04	40	74	40	75	40	76	40	77	40	78	40	79	4C	24	4C	25	4C	26	4C	27
Ip6	40	05	41	00	41	01	41	02	41	03	41	04	41	05	4C	28	4C	29	4C	2A	4C	2B
Ip7	40	06	41	0C	41	0D	41	0E	41	0F	41	10	41	11	4C	2C	4C	2D	4C	2E	4C	2F
Ip8	40	07	41	18	41	19	41	1A	41	1B	41	1C	41	1D	4C	30	4C	31	4C	32	4C	33
Ip9	40	08	41	24	41	25	41	26	41	27	41	28	41	29	4C	34	4C	35	4C	36	4C	37
Ip10	40	09	41	30	41	31	41	32	41	33	41	34	41	35	4C	38	4C	39	4C	3A	4C	3B
Ip11	40	0A	41	3C	41	3D	41	3E	41	3F	41	40	41	41	4C	3C	4C	3D	4C	3E	4C	3F
Ip12	40	0B	41	48	41	49	41	4A	41	4B	41	4C	41	4D	4C	40	4C	41	4C	42	4C	43
Ip13	40	0C	41	54	41	55	41	56	41	57	41	58	41	59	4C	44	4C	45	4C	46	4C	47
Ip14	40	0D	41	60	41	61	41	62	41	63	41	64	41	65	4C	48	4C	49	4C	4A	4C	4B
Ip15	40	0E	41	6C	41	6D	41	6E	41	6F	41	70	41	71	4C	4C	4C	4D	4C	4E	4C	4F
Ip16	40	0F	41	78	41	79	41	7A	41	7B	41	7C	41	7D	4C	50	4C	51	4C	52	4C	53
ST1	40	18	42	64	42	65	42	66	42	67	42	68	42	69	4C	74	4C	75	4C	76	4C	77
ST2	40	1A	42	7C	42	7D	42	7E	42	7F	43	00	43	01	4C	7C	4C	7D	4C	7E	4C	7F
USB	40	1C	43	14	43	15	43	16	43	17	43	18	43	19	4D	04	4D	05	4D	06	4D	07
BT	40	1E	43	2C	43	2D	43	2E	43	2F	43	30	43	31	4D	0C	4D	0D	4D	0E	4D	0F
FX1	40	3C	46	14	46	15	46	16	46	17	46	18	46	19	–	–	4E	05	4E	06	4E	07
FX2	40	3D	46	20	46	21	46	22	46	23	46	24	46	25	4E	08	–	–	4E	0A	4E	0B
FX3	40	3E	46	2C	46	2D	46	2E	46	2F	46	30	46	31	4E	0C	4E	0D	–	–	4E	0F
FX4	40	3F	46	38	46	39	46	3A	46	3B	46	3C	46	3D	4E	10	4E	11	4E	12	–	–

Level Parameter Numbers – Outputs, FX unit input and DCAs (MB / LB)

	Output	
	MSB	LSB
Main LR	4F	00
Out1	4F	01
Out2	4F	02
Out3	4F	03
Out4	4F	04
Out5	4F	05
Out6	4F	06
Out1/2	4F	01
Out3/4	4F	03
Out5/6	4F	05

	to FX unit	
	MSB	LSB
FX1	4F	0D
FX2	4F	0E
FX3	4F	0F
FX4	4F	10

	Control	
	MSB	LSB
DCA1	4F	20
DCA2	4F	21
DCA3	4F	22
DCA4	4F	23

Pan/Balance Parameter Numbers –
Inputs and FX to Main LR and Outputs (MB/LB)

	LR		Out1/2		Out3/4		Out5/6	
	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB
Ip1	50	00	50	44	50	46	50	48
Ip2	50	01	50	50	50	52	50	54
Ip3	50	02	50	5C	50	5E	50	60
Ip4	50	03	50	68	50	6A	50	6C
Ip5	50	04	50	74	50	76	50	78
Ip6	50	05	51	00	51	02	51	04
Ip7	50	06	51	0C	51	0E	51	10
Ip8	50	07	51	18	51	1A	51	1C
Ip9	50	08	51	24	51	26	51	28
Ip10	50	09	51	30	51	32	51	34
Ip11	50	0A	51	3C	51	3E	51	40
Ip12	50	0B	51	48	51	4A	51	4C
Ip13	50	0C	51	54	51	56	51	58
Ip14	50	0D	51	60	51	62	51	64
Ip15	50	0E	51	6C	51	6E	51	70
Ip16	50	0F	51	78	51	7A	51	7C
ST1	50	18	52	64	52	66	52	68
ST2	50	1A	52	7C	52	7E	53	0
USB	50	1C	53	14	53	16	53	18
BT	50	1E	53	2C	53	2E	53	30
FX1	50	3C	56	14	56	16	56	18
FX2	50	3D	56	20	56	22	56	24
FX3	50	3E	56	2C	56	2E	56	30
FX4	50	3F	56	38	56	3A	56	3C

CQ MIDI Protocol, Firmware V1.2.0, issue 4.

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