June 2006 (Rev -)

Chroma CPU Plus (CC+)

Installation Instructions and User's Guide

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## Foreward & Introduction

Congratulations on your purchase of a Chroma[1] CPU Plus (CC+).

This document is intended provide guidance on the installation of the CPU board (and cables) as well as to provide information on the new features and how existing documentation does (or does not) reflect the operation of the new interface.

Each CC+ unit was assembled and tested before shipment, and comes pre-loaded with 4 banks of patches.

If you encounter any difficulties with the received materials, please contact:
- David Clarke (agclarke@istar.ca)
- Sandro Sfregola (sandro.sfregola@virgilio.it)

For queries on general usage or requests for additional features/changes to features, it is probably best to have those discussions in the ChromaTalk forum so others can also participate.

The CC+ is intended to be a fully functional Rhodes Chroma and Rhodes Chroma Expander CPU board. In addition to serving as a replement for failed or damaged original Chroma boards, the CC+ also provides the following additional new functionalities:

- Built-in support for 4 banks of 50 patches;
- Native (on-board) MIDI support, including the ability to have all Chroma controllers sent/received via MIDI CC;
- MIDI SyxEx implementation which directly allows the load/dump of patches in Syntech format;
- Support for custom MIDI controller maps;
- Built in hardware interface to support a future alphanumeric display;
- Local Control mode;
- 'One touch' scratch patch creation;
- Voice Watch mode;
- Battery-less operation;
- One EPROM load for both the Chroma and Expander (i.e., CPU boards directly interchangeable between the Chroma and Expander without the need to install different software);
- Lower power/lower temperature operation; and
- MIDI Activity indicator.

## Installation

Installation can be done without having prior electrical experience as no soldering is required.

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1 Unless specifically noted otherwise, references to "Chroma" are intended to refer to both the Chroma keyboard and the Chroma Expander.

To install the CC+, a screwdriver is required to open the case, remove the existing CPU board, and install the new components.

For those already very familiar with installing/removing boards from the Chroma - a general summary of the required installation steps are:

- Remove old CPU;
- Install new CPU board;
- Install internal cabling (optional); and,
- Install external cabling (optional).

Details of these elements for those less familiar with the Chroma are contained in the following sections.

NOTE: Before opening the Chroma it is strongly recommended to back up any programs/settings from your current CPU board (e.g., use the tape interface or the MIDI SysEx interface to save any/all programs.)

If you will be using the CC+ with an external MIDI interface (like the Syntech/KMX interface), it is also recommended that you write down the exiting settings in use for those interfaces (for instance, for the Syntech interface, programming mode can be enterred by pressing Set Split 46 or "46", depending on the version of firmware installed).

**Unpacking the CC+**

The CC+ package will come with:
- a CC+ board in an antistatic bag and,
- two (2) mounting rails.

If the optional Interconnection Kit was also purchased, the kit will also include:
- an internal cable (to connect the CC+ to the back panel) and,
- an external MIDI interface cable (from the Chroma back panel.)

One package of mounting hardware (with the necessary installation components) is also provided.

Carefully open the cardboard shipping box to reveal the contents and confirm that the expected items have been received.

**Figure 1: Packaged CC+**



**Figure 2: Opened CC+ Box**
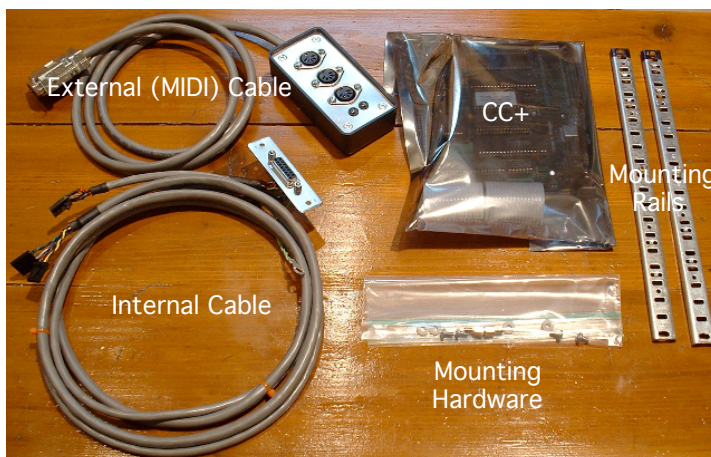


**Figure 3: Unpacked Components**

It is recommended that the CC+ be left in its antistatic bag until just before it is placed in the Chroma.

**<u>Removing the Old CPU board</u>**

To perform the upgrade, the Chroma will need to be opened to expose the location of the existing CPU board.

To do so, start by ensuring that the power to the Chroma is turned off, then unplug the power cord.

A disassembly procedure is provided in the Rhodes Chroma Service Manual (ref: Section 3 of that document). To recap that material, remove the nine screws from the back of the unit and the four screws holding down the front edge of the top panel (screws 1-9 and 11-14 as shown in Figure 4).

NOTE:  Screw #10 holds a ground wire to the cover with a nut.  Only remove this screw if it is desired to set the panel aside to allow for more working space.
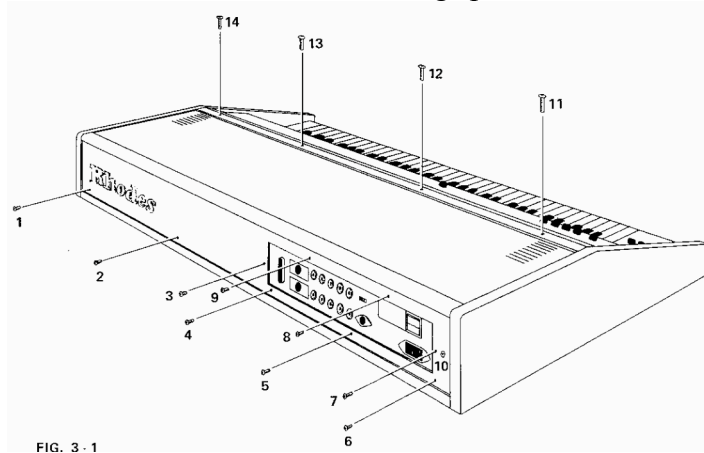


**Figure 4:  Location of Rear Panel/Top Panel Screws**

If you are using an Expander, remove the two screws that hold down the middle of the front panel, as below:
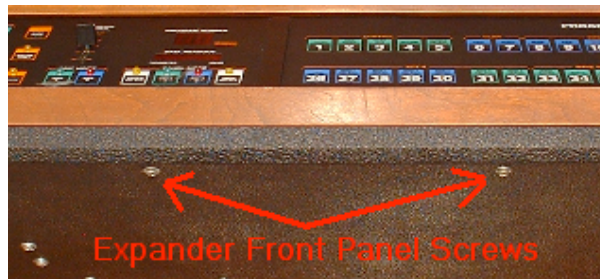


**Figure 5:  Location of Expander Front Panel Screws**

To gain access to the CPU board, remove the 4 screws holding the front panel in place (screws 15-18, shown in Figure 6).
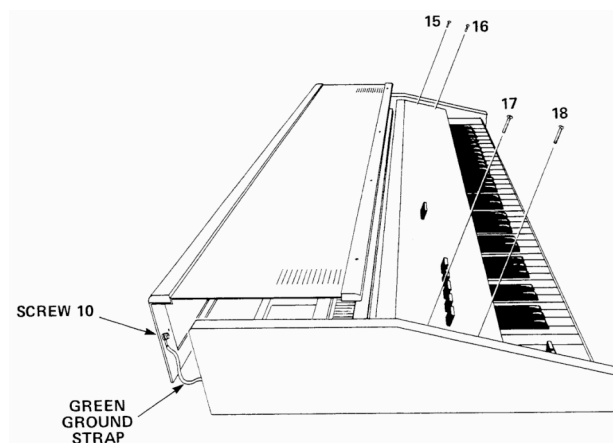


**Figure 6:  Front Panel Screws**

The front panel can now pivot upwards, and will rest in an open position as shown in Figure 7.
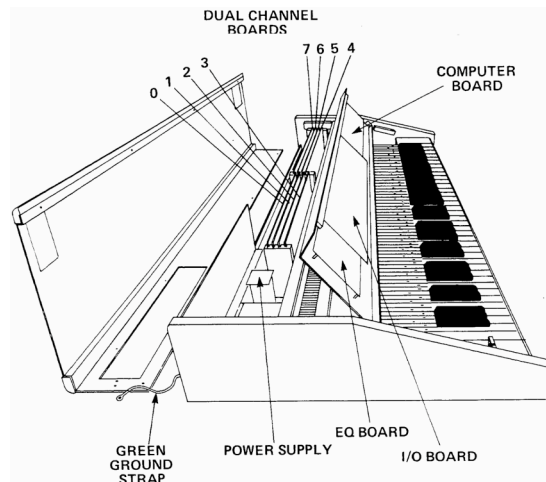
**Figure 7:  Pivoting of Lid, and Access to CPU Board**

It is the 'computer board' which is of interest.

If possible, remove the two AA batteries then grab the ribbon connectors by the plastic shroud on I/O board and pull outward to disconnect.  (Holding the connector plastic between your thumb and forefinger and pulling with a slight 'wiggle' works well).
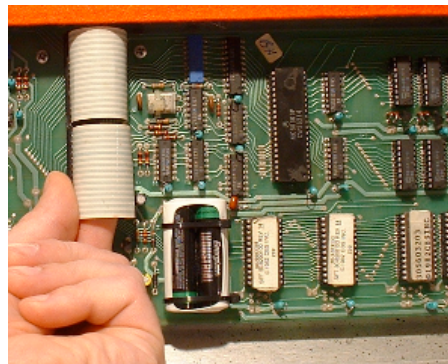


Remove the four (4) screws holding the CPU board in place.  Before removing the final two screws, be sure to support the CPU board (to keep it from sliding/dropping when the last screws are removed).

At this point in time the old CPU is completely removed from the Chroma.

**Installing the New CPU board**

Installation of the new board is essentially a reversal of the steps above.  As the new board is shorter than the original, a set of support rails will be used to allow mounting.

The rails should be installed first.  Install the rails with the blackened end closeest to the I/O board.  You can use two of the screws removed from the original CPU board to attach the right hand side of the rails.  Use a provided 'standoff' to attach the left end.
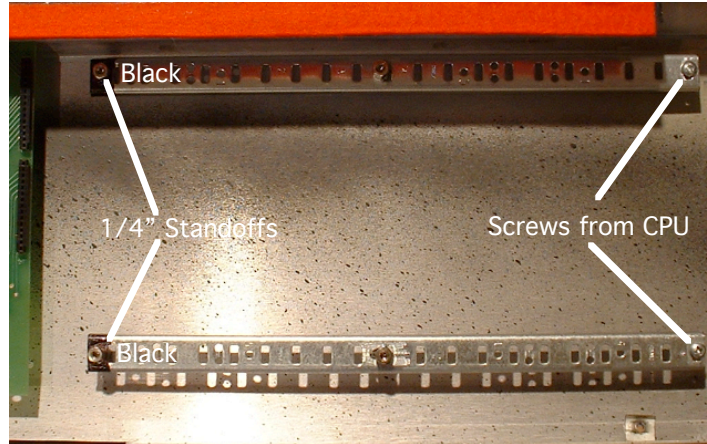
**Figure 8:  Installation of Mounting Rails**

Before opening the bag containing the new CPU board, discharge any static which may have accumulated on your body by touching a known grounded item.

Open the antistatic bag and place the CC+ on the rails.  Using the supplied hardware, install the CC+ so that the ribbon cables are in the same general orientation as the old CPU board.  The CC+ is mounted with 1/4 inch screws and a washer, as shown in Figure 9.
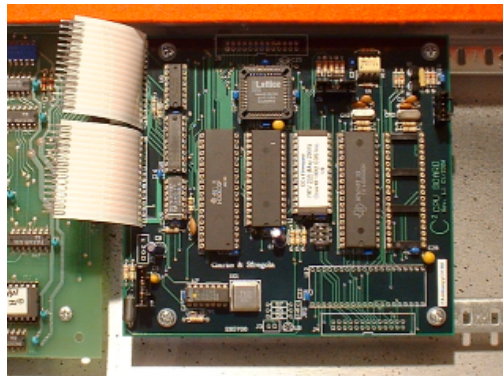


**Figure 9:  Installed CC+ Circuit Board**

The next step will be to connect the ribbon connectors from the CPU board to the I/O board. You will note that the CC+ does not have the same plastic shrouds on the cables as the original CPU connectors.  Remove the protective foam installed on the cable ends for shipping and use your thumb and forefinger to guide the insersion of the pins (ref: Figure 10).  Exercise care so as to not bend the pins while they are being inserted.
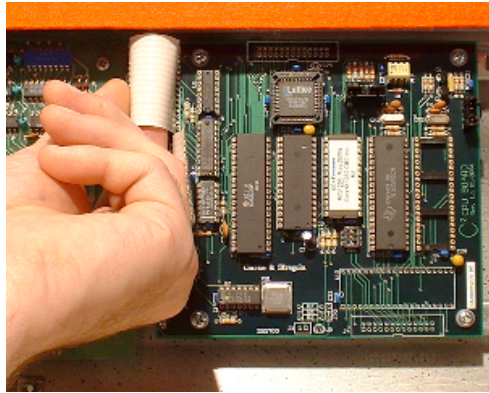
**Figure 10:  Installing Ribbon Connectors**

At this point in time, the CC+ is fully installed.  If no cabling was purchased, you can proceed directly to the "Closing the Chroma and Checkout of CC+" section.

## Installing Internal Cabling

While it is possible to use the CC+ without an interconnection kit - the kit is recommended to facilitate connection of MIDI to the CC+, and allow the new MIDI features to be easily accessed.

The internal cabling connects to the CC+ and terminates on the rear panel of the Chroma.  In addition to the MIDI signals, this interface also terminates serial display features in support of future feature additions to the CC+.

To install the internal cabling, first remove the existing, factory installed blank panel at the rear of the Chroma.
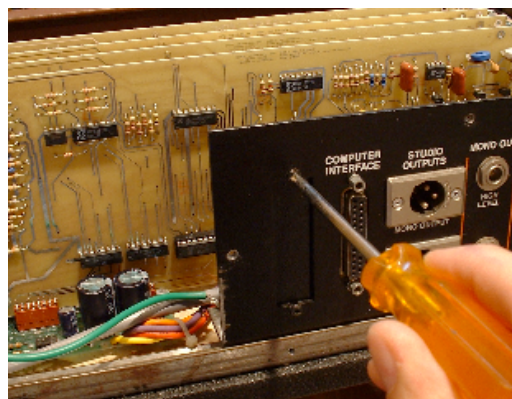


**Figure 11:  Removal of Back Panel Blank**
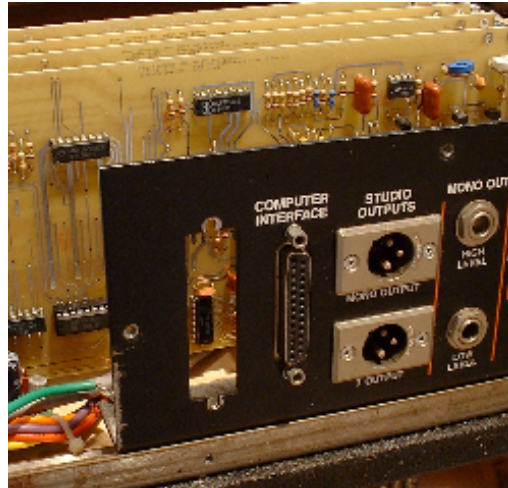
**Figure 12:  Panel Blank Removed**

Remove the screws, nuts and washers from the original panel, as these will be used for the installation of the new cable.  (The panel itself can be set aside in a safe location, so that it can be reinstalled in the Chroma in future, if desired).

Install a screw loosely in bottom hole of the internal cable bracket and slide the connector into pack panel, having the bottom screw meet with the lower panel - as illustrated in Figure 13).  Install the top screw with nut and washer.  (Note – be careful not to loose the small washers inside the Chroma).  Tighten both top and bottom screws.
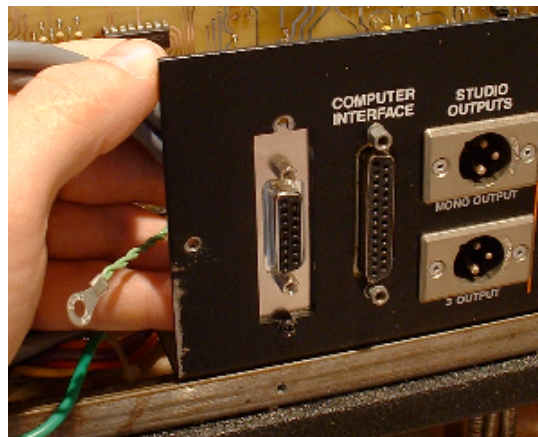


**Figure 13:  Installation of Cable to Rear Panel**

From an electrical perspective, the cable screens need to be connected to a 'ground.' There is an existing ground connection near the back connector, as shown in Figure 14.
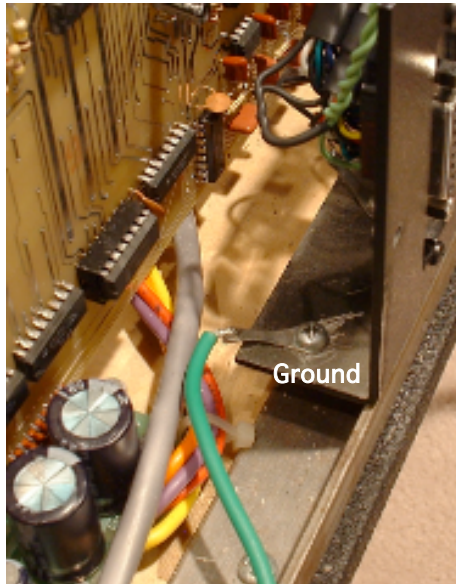


**Figure 14: Location of Pre-Existing Ground**

Remove the screw from the existing back-panel ground wire and place the ground-wire from new cable under it. To prevent possible damage to the Chroma, please double-check that the original ground connection was firmly reattached.



**Figure 15: Cable Ground Connected to Panel Ground**

The location of cable routing is not critical however, it is suggested to pass the cable along the back edge of the Chroma, along the sides and over the dual-stack switch assembly, as shown below.
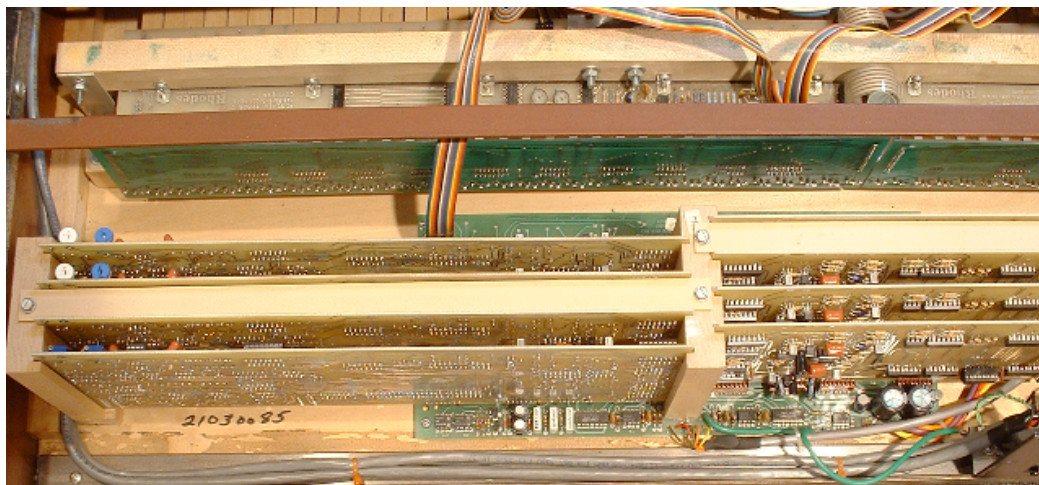


**Figure 16: Internal Cable Routing**

Route the cable under the rails, and towards the connectors.
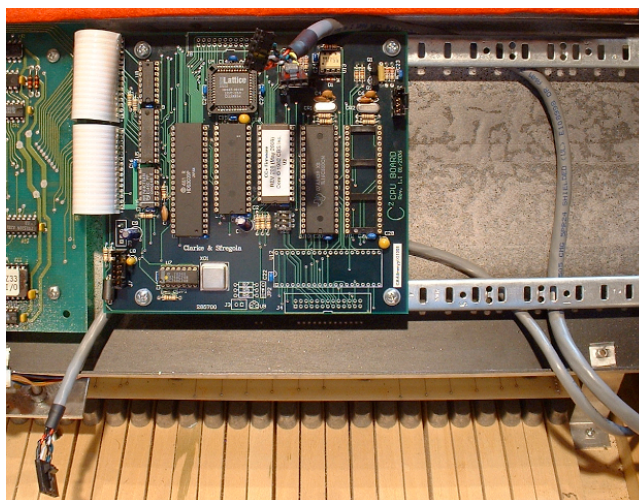


**Figure 17: Cable Routing at CC+**

Attach the connectors of the cable to the CC+ board. When properly seated, the connectors should 'snap' into place and resist being removed. The cable with the single 6-position connector goes to the bottom left location on the board. The cable with the 6-position connector and the 4-position connector goes to the upper right locations on the board.

Secure the CC+ cabling with tie-wraps (included). There is no 'right' or 'wrong' way to secure the cables - simply ensure that the cables will not interfere with the opening and closing of the panel or the operation of the keys (when the lid is closed). Figure 18 suggests some tie-wrap attachment points.
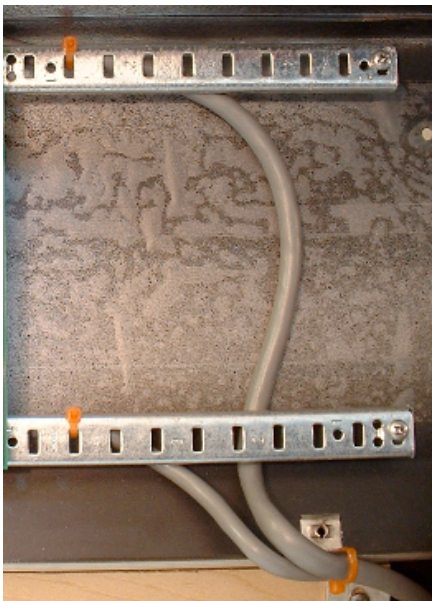
**Figure 18: Suggested Locations to Secure Cable**

## Installing External Cabling

The external cable has a DB-15 connector at one end to allow attachment to the rear panel of the Chroma and an interface box with MIDI IN/THRU/OUT connectors at the other end to support MIDI connection. The interface box also provides two Light-Emitting Diodes (LEDs), one red and one green. The green LED is used as an external indication of MIDI activity. The red LED is reserved for future use. (Specific connector/LED assignments for the connector are available in the section entitled "MIDI Connector Assignments/LED Assignments").

The external cable has a standard computer-style connector and it can be attached to the Chroma by inserting the DB-15 into the mating rear panel location and then tightening the two screws, as shown below.
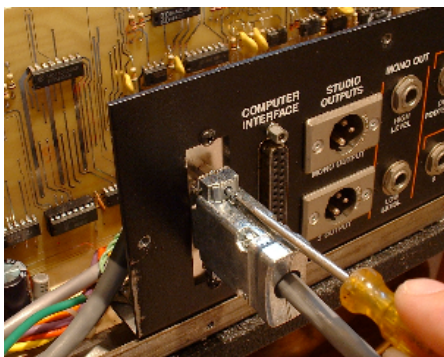


**Figure 19: Installing External Cable**

**Closing the Chroma and Checkout of CC+**

To close the Chroma reverse the earlier sequence of steps which were used to open the unit. Specifically, secure the front panel and install the screws for the lid. Once the system has been reassembled, the installation is complete and the unit can be checked for operation.

Proper installation of the CC+ can be confirmed by powering up the unit. Upon applying power, the Chroma should start as per normal (i.e., flashing LEDs to indicate tuning is being performed).

If the Chroma has properly started as per normal, then the CC+ has been properly installed and all the new features outlined in the User's Guide portion of this document should be available.

After booting, the only item which will appear 'different' from an original CPU boot will be that an additional LED should be illuminated in the small LED display, as below:



**Figure 20:  Extra Decimal Point in DATA READOUT Showing Bank**

This LED signifies that the Chroma is currently using patch bank 1.

**Congratulations on your successful installation!**

If any difficulties were encountered, please refer to the Troubleshooting section of this document.

## User's Guide

The CC+ provides 'an extension to the original functionality' of the Chroma, building on the last production released firmware from CBS/Rhodes/Fender (Rev 14) and adhering to some of the data formats supported by the Chroma Cult/Syntech/KMX MIDI interface.

New features have been kept as compatible as possible with the pre-existing interfaces, and so the following pre-existing documents are still good/appropriate references for a CC+ equipped Chroma:

- Rhodes Chroma Programming Manual
- Rhodes Chroma Performance Manual
- Rhodes Chroma Parameter Chart
- Rhodes Chroma Service Manual
- Rhodes Chroma Computer Interface Manual
- [Syntech/Chroma Cult/KMX] Chroma MIDI Converter Users Manual

The following sections outline those areas where the operation of the CC+ differs from that discussed in the documents above.

### Support for 4 Banks of 50 Patches

The original Chroma documentation describes the programs by saying "…there are fifty programs in the Chroma's memory that can be called upon at any time, numbered 1 through 50. There is a fifty-first program (program 0) that controls the sound of the instrument."

The CC+ now offers storage for 200 programs (201, including 'program 0').  It does so in terms of 4 banks of 50 programs each.  At any time there is always a 'base bank of 50 programs", and that base bank will operate identically to the original documented functionality for the Chroma. By selecting a different bank, the contents of the newly select bank are moved to the 'base bank' and once again, the Chroma behaves as if it only has those initial 50 banks to operate on.

In terms of the banks, the 'current' bank is represented by the decimal points in the small `DATA READOUT` display on the front of the Chroma.

Under normal circumstances, one of the decimal points in the display will be illuminated - and that decimal point will represent the bank, as below:

```
Bank 1:
8.8 8 8 8 8 8

Bank 2:
8 8 8.8 8 8 8

Bank 3:
8 8 8 8 8.8 8 8

Bank 4:
8 8 8 8 8 8 8.8
```

To change banks from MIDI you can issue a Program Change of "50 + desired bank". For instance, a Program Change of 51 would result in selecting bank 1. A Program Change of 52 would result in selecting bank 2, and so on.

To change banks from the Front Panel, hold down the "Prog Select" button in the "Panel Mode" section, and then press the number associated with the desired bank in the "Program Select/Parameter Select" section. In summary:

```
[Prog Select] + [1] = Bank 1
[Prog Select] + [2] = Bank 2 ...
```

Whichever method is chosen, the display will reflect the newly chosen bank.

When a bank is selected, the program which was previously the 'active' program is still active following the bank switch. For instance, if you had been using program 5 from bank 1 and then switched to bank 3, then program 5 from bank 1 will still be the one which is 'active'. This is signified by "5" still being present as the current program number, and the "Prog Modified" flag being present in the display.

It is exactly this 'carrying over' of the active/current patch data which can be used to copy patches from one bank to another. For instance, you can select a patch you like from bank X, make it current, switch to bank Y, save current patch in bank Y.

Linking is a bank inclusive operation - i.e., you can not link across banks.

NOTE: Since the MIDI bank change is controlled by a program change - if the MIDI interface is configured to disallow MIDI program changes - then bank changes from MIDI are similarly disabled.

## Additional User Interface Options

The Chroma uses key combinations of Set-Split + {number} for certain functions. The following sections outlines additional combinations added by the CC+, as well as slight clarifications on functionality for existing combinations.

### Set Split 6  Show "Battery" Voltage

The original Chroma CPU required two AA batteries in order to maintain the memory settings. The system allowed the general state of the batteries to be checked by pressing [SET SPLIT] then [6] to see the battery voltage. The recommendation from the manuals was to replace the batteries whenever the value was less than 2.5V.

The CC+ does not have (nor does it require) batteries - but to maintain functionality, the board has been set up to provide a fixed voltage to the battery monitoring circuitry. Pressing [SET SPLIT] then [6] with the CC+ will provide a voltage on-board the CPU board itself, and should always return a value greater than 2.5V (this voltage will be approx. 3.0V).

**Set Split 36  Enter/Exit Programming Mode**

For familiarity of operation, the configuration interface used for the CC+ is similar in structure to that used for the Syntech MIDI interface.  For the Syntech interface, the MIDI Programming Mode is entered by pressing Set Split 46. Upon entering this mode, the large LED display shows "Pr" to confirm that programming mode has been entered.

For the CC+, pressing Set Split 36 will enter Programming Mode. To provide a visual indication that it is the CC+ code which is running, the large LED display is configured to display "EP" (which stands for 'extended programming' mode).  Details of the selections available in Programming Mode are outlined in the Configuration Interface & MIDI Support section of this document.

**Set Split 37  Show Voice Allocations**

When Set Split 37 is pressed, the Chroma will toggle in to/out of 'Voice Display' mode. In Voice Display mode, the 8-digit LED display will be used to show the voice activity.

The 8 digits of the display are used to represent the 8 dual-channel voice cards, with the top-part of the digit used to represent the "A" voices and the bottom-part of the digit used to represent the "B" voices.

In all voice allocation modes (except for the 'sequencer' modes), the Chroma keeps track of whether the voice is 'released', 'latched' or 'held'.

Voice Display mode dynamically shows which channels are active.  This can be used to give a feel for how many channels are still free (i.e., which could still be assigned to other sounds), or even to assist with debuging (to determine which channel of which voice card is currently sounding).

In terms of output, a 'held' note (such as you'd get when you simply hold down notes on the keyboard) are shown differently than a 'latched' note (which you'd get via a pedal).

Each of these digits has seven segments, as below:



When an "A" voice is 'held', the whole top portion of the digit is lit, as below:



When a "B" voice is 'held', the whole bottom portion of the digit is lit, as below:

If a particular voice is latched, only the top-most segment (for 'A') or bottom-most (for 'B') is shown.

The representation below illustrates what would appear in the display if, for instance, Channel A0, B0, A1, B1, A5, B6 and B7 were 'held' with A2, A3 and B4 'latched':
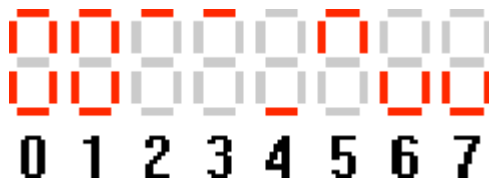
The assignment indications change dynamically as the Chroma is played (either from the keyboard, from MIDI or both).

Pressing Set Split: 37 again returns the display back to its previous (normal) contents.

No data is shown when running in 'random' or 'arpeggio' modes. Also, you must exit from this mode before being able to enter Set Split 36 mode.

## Set Split 39 Create Scratch Patch (Program 0)

As documented in the Chroma manuals, you can create 'scratch patch' by selecting the "Edit A" and "Edit B" buttons, and then holding down the "Param" button while pressing each of the 50 Chroma parameter buttons in turn. This certainly works, but it can be a bit more work than you would sometimes like. (You've got to use both hands, and perform over 50 key presses to get a scratch patch).

Set Split 39 was set up to be a 'shortcut' to this procedure. Specifically, pressing Set Split 39 will cycle through all the parameters and create the scratch patch, leaving the results stored in the 'current' program. The display will change to show "0" as the current program number.

This patch can then be modified as desired, stored in whatever memory location you desire like.

## Set Split 20/46/47/48/49 Syntech-Specific Settings

The Syntech interface uses certain panel controls for MIDI-specific functions. While the CC+ has implemented MIDI SysEx data structures similar to the Syntech MIDI interface, the front panel controls for that interface were not duplicated on the CC+.

If you are not using a Syntech MIDI interface, then the Syntech-specific 'set split' commands (Set Split 20, 46, 47, 48 and 49) are not active.

If you are using a Syntech MIDI interface – then those commands will still be fully supported with the CC+, and will control Syntech functions/features.

## Configuration Interface & MIDI Support

The Syntech/Chroma Cult MIDI Programming Mode offers 16 settable parameters, which are selected by pressing parameter buttons 1-16.  The CC+ has analogous settings.  Of the first 16, all except P2 have the same function as the Syntech interface and are selectable and editable in the same way.

For the Syntech interface, parameter 2 selects whether the Chroma is in Omni mode or not.  For the CC+, P2 selects between "normal" and "play" mode.  "Normal" mode is essentially the same as "Omni off".  "Play" mode is very similar to the Syntech "omni on" mode, with the notable difference that the instrument will only receive on the selected base channel - but the Chroma will play links, splits, etc - just as it would in omni mode.

The 16 initial parameters are summarized below:

| P1 | Base Channel (1-16) | |
|---|---|---|
| P2 | Mode | |
| P3 | MIDI Out/Thru | While the selection will allow you to specify Out or Thru, the setting itself will not change the behaviour of the interface.  Specifically, the interface is designed to have In/Out/Thru, and so Thru and Out are always available. |
| P4 | Program Changes | Also controls whether MIDI Program changes are sent (i.e., if this is 'off', then local program changes will not get sent over MIDI).  Note - since banks are selected via a 'program change' - if MIDI program changes are disabled, MIDI bank changes are similarly disabled. |
| P5 | Instruments Available | |
| P6 | Parameter Changes | NOTE:  This is strictly for channel 'parameters'.  Items such as 'Volume, Lever 1, Lever 2, Pedal 1, Pdeal 2, Footswtich, etc. are not turned off/controlled by this parameter.<br><br>Same note applies for both Sending and receiving of parameters. |
| P7 | Lever 1 Select | |
| P8 | Lever 1 Polarity | |
| P9 | Lever 2 Select | |
| P10 | Lever 2 Polarity | |
| P11 | Pedal 1 Select | |
| P12 | Pedal 2 Select | |
| P13 | Footswitch 2 Select | |
| P14 | Volume Select | |
| P15 | Param Slider Select | |
| P16 | MIDI Pressure Mode | |

Over and above the 16 'standard' parameters supported by Syntech and CC+, the CC+ firmware adds on an additional number of settings, as outlined below:

| P17 | Local Control (On/Off) | If Local Off is selected, notes played on the Chroma keyboard do not trigger the internal sound generators of the instrument; but rather are only transmitted via MIDI. |
|---|---|---|

| | | |
|---|---|---|
| | | Local Control On would configure the Chroma to operate as per the Syntech default.<br><br>In either mode (local on or local off), the Chroma is still fully capable to receive (and play) sounds via MIDI. |
| P18 | MCM Mode Selection | You can select a 'MIDI Controller Map' to use the same assignments as the Syntech interface – or a custom/user provided mapping.<br>Cult = Use Emulation Mode MCM (Syntech Mode)<br>Cust = Use Expanded Mode (custom MCM Mode) |
| P19 | Edit MCM | This selection allows the user to modify/edit/review the mapping in the current controller map.<br><br>When selected, the small LED display shows the controller number to the left ("C" followed by 000-127) and the destination Chroma Parameter to the right (000-127). Moving the slider changes the controller number. Pressing "Edit A" will instruct the slider to make changes to the controller number. Pressing "Edit B" will instruct the slider to make changes to the destination parameter number. |
| P20 | Init MCM | Parameter 20 provides a quick, convenient way to reset the Expanded MCM back to a known state. This effectively resets any changes made with P19 and allows the user to start fresh.<br><br>To protect against those times when you might accidentally enter this mode - and you don't want your custom edited MCM to be erased, when P20 is first pressed, no changes are made - but the display will say "Init"<br><br>If you leave this parameter - no changes will have been made.<br><br>If you do want to initialise the MCM however, simply move the parameter slider while the "Init" message is on the screen, and the MCM will be reset to the value stored in ROM. |
| P21 | MCM SysEx Dump | When selected, the MCM is dumped via SysEx (to allow a custom map to be stored on computer, for later use – for instance). |
| P22 | Configure Panel/Keyboard Mode | 0 = Configure Interface for the Chroma (Chro)<br>1 = Configure Interface for the Expander (Pndr) |
| P23 | Fifty Program SysEx Dump Request | Initiates a dump of 50 program data to MIDI via SysEx |
| P24 | | (currently unused) |
| P25 | Display Firmware Version | Place 3-digit the CC+ version number is the small LED display. |

## MIDI Controllers Map

The original Syntech/Chroma Cult interface maps the MIDI controllers to Chroma parameters in a predefined way and only a subset of the full number of Chroma control sources are available. Also, the performance controllers (Lever 1-2, Pedal 1-2, Footswitch 1-2, Volume) can only assigned to a limited number of Continuous Controllers (CCs) (normally adequate in a typical MIDI setup).

The MIDI implementation of the CC+ introduces the MIDI Controllers Map (MCM) functionality, a concept that is widely available on recent instruments. The MCM allows the user to assign each of the 128 available MIDI CCs to one of the 120 possible Chroma control

"destinations".  These destinations include all the Chroma parameters and the performance controllers with room for future additions, as presented in Table 1.

**Table 1:  Chroma Parameter Assignment**

| Chroma Parameter # | Destination Item | Chroma Parameter # | Destination Item |
|---|---|---|---|
| 000 | Not assigned (off) | 064 | B-Env1 Attack |
| 001 | Patch | 065 | B-Env1 Attack Mod |
| 002 | Fsw Mode | 066 | B-Env1 Decay |
| 003 | Kybd Alg | 067 | B-Env1 Decay Mod |
| 004 | Detune | 068 | B-Env1 Release |
| 005 | Out Select | 069 | B-Env2 Delay |
| 006 | A-Glide Rate | 070 | B-Env2 Ampl Touch |
| 007 | A-Glide Shape | 071 | B-Env2 Attack |
| 008 | A-Sweep Mode | 072 | B-Env2 Attack Mod |
| 009 | A-Sweep Rate | 073 | B-Env2 Decay |
| 010 | A-Sweep Rate Mod | 074 | B-Env2 Decay Mod |
| 011 | A-Sweep Wave Shape | 075 | B-Env2 Release |
| 012 | A-Sweep Ampl Mod | 076 | B-Pitch Tune |
| 013 | A-Env1 Ampl Touch | 077 | B-Pitch Mod1 Select |
| 014 | A-Env1 Attack | 078 | B-Pitch Mod1 Depth |
| 015 | A-Env1 Attack Mod | 079 | B-Pitch Mod2 Select |
| 016 | A-Env1 Decay | 080 | B-Pitch Mod2 Depth |
| 017 | A-Env1 Decay Mod | 081 | B-Pitch Mod3 Select |
| 018 | A-Env1 Release | 082 | B-Pitch Mod3 Depth |
| 019 | A-Env2 Delay | 083 | B-Wave Wave Shape |
| 020 | A-Env2 Ampl Touch | 084 | B-Wave Width |
| 021 | A-Env2 Attack | 085 | B-Wave Mod Select |
| 022 | A-Env2 Attack Mod | 086 | B-Wave Mod Depth |
| 023 | A-Env2 Decay | 087 | B-Cutoff LP/HP |
| 024 | A-Env2 Decay Mod | 088 | B-Cutoff Resonance |
| 025 | A-Env2 Release | 089 | B-Cutoff Tune |
| 026 | A-Pitch Tune | 090 | B-Cutoff Mod1 Select |
| 027 | A-Pitch Mod1 Select | 091 | B-Cutoff Mod1 Depth |
| 028 | A-Pitch Mod1 Depth | 092 | B-Cutoff Mod2 Select |
| 029 | A-Pitch Mod2 Select | 093 | B-Cutoff Mod2 Depth |
| 030 | A-Pitch Mod2 Depth | 094 | B-Cutoff Mod3 Select |
| 031 | A-Pitch Mod3 Select | 095 | B-Cutoff Mod3 Depth |
| 032 | A-Pitch Mod3 Depth | 096 | B-Volume Mod1 Select |
| 033 | A-Wave Wave Shape | 097 | B-Volume Mod1 Depth |
| 034 | A-Wave Width | 098 | B-Volume Mod2 Select |
| 035 | A-Wave Mod Select | 099 | B-Volume Mod2 Depth |
| 036 | A-Wave Mod Depth | 100 | B-Volume Mod3 Select |
| 037 | A-Cutoff LP/HP | 101 | Lever 1 |
| 038 | A-Cutoff Resonance | 102 | Lever 2 |
| 039 | A-Cutoff Tune | 103 | Pedal 1 |
| 040 | A-Cutoff Mod1 Select | 104 | Pedal 2 |
| 041 | A-Cutoff Mod1 Depth | 105 | Footswitch 1 |
| 042 | A-Cutoff Mod2 Select | 106 | Footswitch 2 |
| 043 | A-Cutoff Mod2 Depth | 107 | Volume |
| 044 | A-Cutoff Mod3 Select | 108 | Unused (free) |
| 045 | A-Cutoff Mod3 Depth | 109 | Unused (free) |

| Chroma Parameter # | Destination Item | Chroma Parameter # | Destination Item |
|---|---|---|---|
| 046 | A-Volume Mod1 Select | 110 | Unused (free) |
| 047 | A-Volume Mod1 Depth | 111 | Unused (free) |
| 048 | A-Volume Mod2 Select | 112 | Unused (free) |
| 049 | A-Volume Mod2 Depth | 113 | Unused (free) |
| 050 | A-Volume Mod3 Select | 114 | Unused (free) |
| 051 | Not assigned (off) | 115 | Unused (free) |
| 052 | Not assigned (off) | 116 | Unused (free) |
| 053 | Not assigned (off) | 117 | Unused (free) |
| 054 | Not assigned (off) | 118 | Unused (free) |
| 055 | Not assigned (off) | 119 | Unused (free) |
| 056 | B-Glide Rate | 120 | Unused (free) |
| 057 | B-Glide Shape | 121 | Unused (free) |
| 058 | B-Sweep Mode | 122 | Unused (free) |
| 059 | B-Sweep Rate | 123 | Unused (free) |
| 060 | B-Sweep Rate Mod | 124 | Unused (free) |
| 061 | B-Sweep Wave Shape | 125 | Unused (free) |
| 062 | B-Sweep Ampl Mod | 126 | Unused (free) |
| 063 | B-Env1 Ampl Touch | 127 | Unused (free) |

The default MCM which is installed with Enhanced Programming (Set Split 36, P20) is below. This map attempts to provide a direct mapping for all the standard front-panel parameters on the Chroma.

| MIDI CC# | MCM Dest# | Dest. Item | MIDI CC# | MCM Dest# | Dest. Item |
|---|---|---|---|---|---|
| 1 | 101 | Lever 1 | 60 | 0 | |
| 2 | 0 | | 61 | 0 | |
| 3 | 0 | | 62 | 0 | |
| 4 | 103 | Pedal 1 | 63 | 0 | |
| 5 | 0 | | 64 | 105 | Footswitch 1 |
| 6 | 0 | | 65 | 0 | |
| 7 | 107 | Volume | 66 | 0 | |
| 8 | 0 | | 67 | 106 | Footswitch 2 |
| 9 | 0 | | 68 | 0 | |
| 10 | 6 | A-Glide Rate | 69 | 0 | |
| 11 | 7 | A-Glide Shape | 70 | 56 | B-Glide Rate |
| 12 | 8 | A-Sweep Mode | 71 | 57 | B-Glide Shape |
| 13 | 9 | A-Sweep Rate | 72 | 58 | B-Sweep Mode |
| 14 | 10 | A-Sweep Rate Mod | 73 | 59 | B-Sweep Rate |
| 15 | 11 | A-Sweep Wave Shape | 74 | 60 | B-Sweep Rate Mod |
| 16 | 12 | A-Sweep Ampl Mod | 75 | 61 | B-Sweep Wave Shape |
| 17 | 13 | A-Env1 Ampl Touch | 76 | 62 | B-Sweep Ampl Mod |
| 18 | 14 | A-Env1 Attack | 77 | 63 | B-Env1 Ampl Touch |
| 19 | 15 | A-Env1 Attack Mod | 78 | 64 | B-Env1 Attack |
| 20 | 16 | A-Env1 Decay | 79 | 65 | B-Env1 Attack Mod |
| 21 | 17 | A-Env1 Decay Mod | 80 | 66 | B-Env1 Decay |

| MIDI CC# | MCM Dest# | Dest. Item | MIDI CC# | MCM Dest# | Dest. Item |
|---|---|---|---|---|---|
| 22 | 18 | A-Env1 Release | 81 | 67 | B-Env1 Decay Mod |
| 23 | 19 | A-Env2 Delay | 82 | 68 | B-Env1 Release |
| 24 | 20 | A-Env2 Ampl Touch | 83 | 69 | B-Env2 Delay |
| 25 | 21 | A-Env2 Attack | 84 | 70 | B-Env2 Ampl Touch |
| 26 | 22 | A-Env2 Attack Mod | 85 | 71 | B-Env2 Attack |
| 27 | 23 | A-Env2 Decay | 86 | 72 | B-Env2 Attack Mod |
| 28 | 24 | A-Env2 Decay Mod | 87 | 73 | B-Env2 Decay |
| 29 | 25 | A-Env2 Release | 88 | 74 | B-Env2 Decay Mod |
| 30 | 26 | A-Pitch Tune | 89 | 75 | B-Env2 Release |
| 31 | 27 | A-Pitch Mod1 Select | 90 | 76 | B-Pitch Tune |
| 32 | 28 | A-Pitch Mod1 Depth | 91 | 77 | B-Pitch Mod1 Select |
| 33 | 29 | A-Pitch Mod2 Select | 92 | 78 | B-Pitch Mod1 Depth |
| 34 | 30 | A-Pitch Mod2 Depth | 93 | 79 | B-Pitch Mod2 Select |
| 35 | 31 | A-Pitch Mod3 Select | 94 | 80 | B-Pitch Mod2 Depth |
| 36 | 32 | A-Pitch Mod3 Depth | 95 | 81 | B-Pitch Mod3 Select |
| 37 | 33 | A-Wave Wave Shape | 96 | 82 | B-Pitch Mod3 Depth |
| 38 | 34 | A-Wave Width | 97 | 83 | B-Wave Wave Shape |
| 39 | 35 | A-Wave Mod Select | 98 | 84 | B-Wave Width |
| 40 | 36 | A-Wave Mod Depth | 99 | 85 | B-Wave Mod Select |
| 41 | 37 | A-Cutoff LP/HP | 100 | 86 | B-Wave Mod Depth |
| 42 | 38 | A-Cutoff Resonance | 101 | 87 | B-Cutoff LP/HP |
| 43 | 39 | A-Cutoff Tune | 102 | 88 | B-Cutoff Resonance |
| 44 | 40 | A-Cutoff Mod1 Select | 103 | 89 | B-Cutoff Tune |
| 45 | 41 | A-Cutoff Mod1 Depth | 104 | 90 | B-Cutoff Mod1 Select |
| 46 | 42 | A-Cutoff Mod2 Select | 105 | 91 | B-Cutoff Mod1 Depth |
| 47 | 43 | A-Cutoff Mod2 Depth | 106 | 92 | B-Cutoff Mod2 Select |
| 48 | 44 | A-Cutoff Mod3 Select | 107 | 93 | B-Cutoff Mod2 Depth |
| 49 | 45 | A-Cutoff Mod3 Depth | 108 | 94 | B-Cutoff Mod3 Select |
| 50 | 46 | A-Volume Mod1 Select | 109 | 95 | B-Cutoff Mod3 Depth |
| 51 | 47 | A-Volume Mod1 Depth | 110 | 96 | B-Volume Mod1 Select |
| 52 | 48 | A-Volume Mod2 Select | 111 | 97 | B-Volume Mod1 Depth |
| 53 | 49 | A-Volume Mod2 Depth | 112 | 98 | B-Volume Mod2 Select |
| 54 | 50 | A-Volume Mod3 Select | 113 | 99 | B-Volume Mod2 Depth |
| 55 | 0 | | 114 | 100 | B-Volume Mod3 Select |
| 56 | 0 | | 115 | 1 | Patch |
| 57 | 0 | | 116 | 2 | Fsw Mode |
| 58 | 0 | | 117 | 3 | Kybd Alg |
| 59 | 0 | | 118 | 4 | Detune |
| | | | 119 | 5 | Out Select |

The MCM is fully editable.

## MIDI System Exclusive (SysEx)

The SysEx format has been implemented in such a way to keep the program dumps 100% compatible with the Syntech/Chroma Cult interface.  Specific details on the SysEx implementation are below.  (Values are in hexadecimal if not otherwise specified.)

Single program dump request:

```
F0 08 00 4B 59 00 pp

F0        System Exclusive
08        Fender ID
00 4B 59  KMX converter ID
00        Dump request (if non 0 denotes dump)
pp        0 to 50 (decimal) program number
          51 = fifty programs
          52 = MIDI parameters file (not yet implemented)
          53 = MCM file
```

Fifty programs dump request:

```
F0 08 00 4B 59 00 33
33 = decimal 51
Single program dump:

F0 08 00 4B 59 7F pp 0h 0l 0h 0l...
(118 data bytes: 59 (dec) data bytes that make up a Chroma program, nibblized and sent
high nibble first)
```

Fifty program dump:

```
F0 08 00 4B 59 7F 33 pp 0h 0l .... pp 0h 0l ....

pp 1 to 50 (dec)
```

Note: a program dump is parsed as it is received – so if the original SysEx has become corrupt, the firmware will still try to store as many complete programs as it can.

MCM dump request:

```
F0 08 00 4B 59 00
```

MCM dump:

```
F0 08 00 4B 59 7F 35 dd dd dd ....

dd = 128 MCM bytes (dec values 0 - 127)
```

## Special Features/Changes

Over and above MIDI and changes to the user-interface, there are other features provided via the addition of the CC+. These items as discussed in the following sections. (The physical location of the DIP switches is highlighted in Board Outline section.)

## Delayed Start

DIP SW#1 = Power on delay.

If DIP switch #1 is in the ON position at power-up/hardware reset, a 2 second delay routine is called before auto-tune. This delay can be used to allow the on-board reference voltage to stabilize before attempting tuning.

## DAC Offset Adjustment Service Mode

DIP SW#2 = Sevice Mode Select

---

If DIP switch #2 is in the ON position at power-up/hardware reset, then after power on initialisation is performed, on-board code execution will be redirected to execute a "service" routine.

This routine writes a zero value to both the main and reference DACs and then executes the SYNC processor instruction. SYNC will cause the CPU to stop, and both the address and data buses will go a high impedance state, minimizing radiated noise. This "static" condition allow for precise offset adjustment at the main DAC op-amp output and to check the offset at the reference DAC.

## One CPU/Program Load for Both the Chroma and Expander

In the past, a different set of on-board EPROMs were required depending on whether you were running a Rhodes Chroma (keyboard-version) or a Rhodes Chroma Expander (keyboardless).

The CC+ interface supports both the Chroma and Expander through the same firmware load. The CC+ configuration interface (Set Split 36), Parameter 22 and the Parameter Control slider will configure the firmware for Chroma or Expander mode.

From that menu, selecting "Chro" will put the firmware into Chroma mode - with full keyboard support as well as Link Upper/Link Lower support. Selecting "Pndr" will select Expander mode, and will remove keyboard support and reconfigure the Panel buttons/LEDs appropriate for the Expander.

When queried over the Chroma port via the 'identification' opcode (ref: the Computer Interface Manual), the CC+ will correctly respond with the Chroma or Expander identification code, as dictated by the "Chro" or "Pndr" selections.

## Changed Memory Map

The Chroma Computer Interface Manual provides a list of addresses as "Useful Locations in the Chroma."

All values in that document for addresses below 0x2000 remain intact with the CC+ while addresses recorded at 0x2000 and above have been relocated.

NOTE: It is known that the Syntech interface make specific use of certain memory locations in the original Chroma firmware, including address 0xC100 as the "Return address" and addresses 0xCD8a and 0xCD90. Provisions have been made in CC+ to allow these addresses to be responded to properly, even while the underlying memory map may have actually changed.

## MIDI Activity Indicator

The large 2-digit LED display on the Chroma's front panel normally shows the Program Number for the current program. The right-most decimal point is used to indicate if there are changes between the 'current' program and the program which has the displayed number.

The decimal point in the middle of the display (i.e., the decimal associated with the left digit in the display) is used to report MIDI activity.  This point will flash when the Chroma is successfully receiving MIDI data.

Out-board, the MIDI interface cable also houses two LEDs.  One of these LEDs (the Green LED) will also signal MIDI activity.

**Troubleshooting**

While it is hoped that no problems will be experienced with the CC+, the following points highlight some possible scenarios, along with some possible solutions and/or items to check.

| Problem | Items to Check |
|---|---|
| CPU does not power up. | Confirm that the connectors were installed into the I/O board fully, with no bent pins. <br> Confirm power cord has been reattached to the Chroma. <br> Confirm that jumpers are not in 'test mode'. <br> If the Chroma has been retrofitted with a switching power supply, confirm that the 'mimimum load' requirement is achieved with the lower-power CC+. <br> Confirm that the Chroma will still boot proper if the original CPU is reinstalled |
| No sounds are heard when keys are pressed, but the Chroma does make sound when MIDI data is received. | The interface may be set to have "Local Off." <br> The interface may be set in Expander Mode vs. Chroma Mode. |
| Can't enter Programming Mode (Set Split 36) | No CC+ installed. <br> Currently in Voice-Watch mode. |
| Link Unison/Link Upper/Link Lower doesn't work properly | Confirm that parameter P22 f(Configure Panel/Keyboard Mode) is set appropriately for the synethisizer that the CC+ is installed in (i.e., Chroma or Expander). |
| The "Data Readout" is all blank - but the keyboard otherwise seems to be OK. | In Voice Watch mode. |
| No MIDI activity is being reported by the LEDs | Wrong base channel selected. <br> MIDI cable disconnected (from the CC+, from the back plane). <br> Wrong cable connection (i.e., MIDI cables installed in wrong locations) |
| I'm not seeing controller data being sent/continuous controllers are not controlling what I would expect. | Check the MCM Mode from the interface. <br> Confirm that the listed controller map is mapping to the controllers expected. |
| I turned on the Chroma, but all the lights stay off for an extended period of time | Check the DIP switches on the board to turn off the startup delay. |

## Default Conditions at Time of Shipping

*The CC+ is shipped with programs pre-loaded in all 4 of the new banks.  The programs used are ones which are available on-line from the Rhodes Chroma web site.  In terms of specifics we have:*

*Bank 1 = Factory Set 1*
*Bank 2 = Factory Set 5*
*Bank 3 = Cool Blue Patches*
*Bank 4 = Factory Set 4*

*The rest of the memory is 'cleared' when shipped, so any specific settings for interfaces such as the Syntech interface will be reset.*
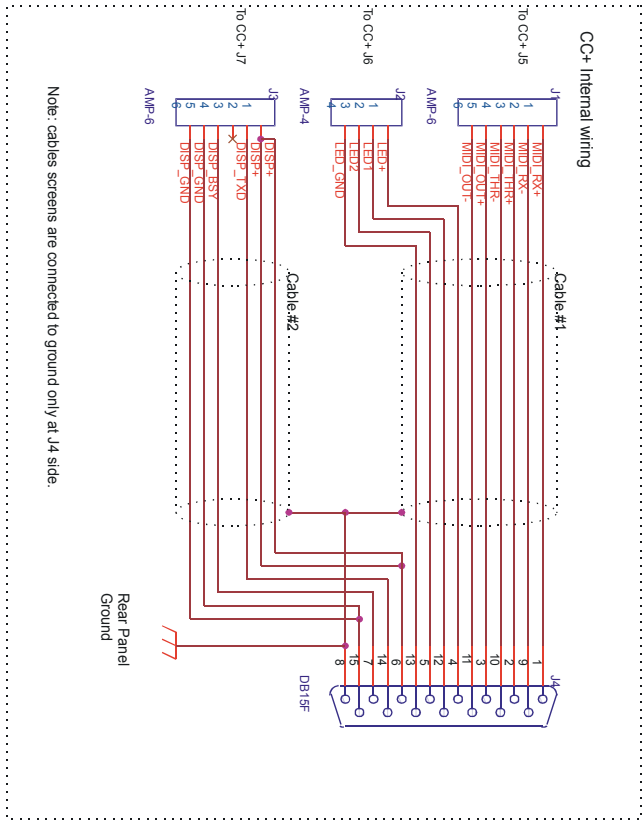
*The following specific settings will be in place (as shipped):*

*Performance Enable/Disable = Disabled (Use [Set Split] [17] to change)*
*Panel Enable/Disable = Disabled (Use [Set Split] [19] to change)*
*Pressure Enable/Disable = Disabled (Use [Set Split] [35] to change)*
*Attack Threshold = 18 (Use [Set Split] [21] to change)*
*Release Threshold = 6 (Use [Set Split] [22] to change)*
*Release Slow Release Rate = 15 (Use [Set Split] [23] to change)*
*Release Fast Release Rate = 5 (Use [Set Split] [24] to change)*
*Tapper = On (Use [Set Split] [9] to change)*
*Cassette Mode = Non-Sensing Mode (Use [Set Split] [10] to change)*

*Programming Interface:*
*        P1 (Base Channel) = 1*
*        P2 (Mode) = Norm*
*        P3 (MIDI Out/Thru) = Out*
*        P4 (Program Changes) = Enabled*
*        P5 (Instruments Available) = 7 (all)*
*        P6 (Parameter Changes) = Enabled*
*        P7 (Lever 1 Select) = MIDI Controller 1 (Mod Wheel)*
*        P8 (Lever 1 Polarity) = Pull*
*        P9 (Lever 2 Select) = Pitch*
*        P10 (Lever 2 Polarity) = Pull*
*        P11 (Pedal 1 Select) = Off*
*        P12 (Pedal 2 Select) = Off*
*        P13 (Footswitch 2 Select) = Off*
*        P14 (Volume Select) = Off*
*        P15 (Param Slider Select) = Off*
*        P16 (MIDI Pressure Mode) = Channel*
*        P17 (Local Control (On/Off)) = On*
*        P18 (MCM Mode Selection) = Cult*
*        P22 (Configure Panel/Keyboard Mode) = Chroma*

# Wiring Diagrams for Internal and External Cables



**CC+ Internal wiring**

To CC+ J5 — J1 (AMP-6): MIDI_RX+, MIDI_RX-, MIDI_THR+, MIDI_THR-, MIDI_OUT+, MIDI_OUT-

To CC+ J6 — J2 (AMP-4): LED+, LED1, LED2, LED_GND

To CC+ J7 — J3 (AMP-6): DISP+, DISP+, DISP_TXD, DISP_BSY, DISP_GND, DISP_GND

Cable #1, Cable #2

Rear Panel Ground

DB15F — J4

Note: cables screens are connected to ground only at J4 side.

Cable 1 = Belden 9505 (or equivalent)
Wire assignments (for Belden 9505)

| Signal | Wire | ...of Pair | From | To |
| --- | --- | --- | --- | --- |
| MIDI_RX+ | Red | Black/Red | J1-1 | J4-1 |
| MIDI_RX- | Black | Black/Red | J1-2 | J4-9 |
| MIDI_THR+ | White | Black/White | J1-3 | J4-2 |
| MIDI_THR- | Black | Black/White | J1-4 | J4-10 |
| MIDI_OUT+ | Green | Black/Green | J1-5 | J4-3 |
| MIDI_OUT- | Black | Black/Green | J1-6 | J4-11 |
| LED+ | Blue | Black/Blue | J2-1 | J4-4 |
| LED1 | Black | Black/Blue | J2-2 | J4-12 |
| LED2 | Yellow | Black/Yellow | J2-3 | J4-5 |
| LED_GND | Black | Black/Yellow | J2-4 | J4-13 |

Cable 2 = Belden 9503 (or equivalent)
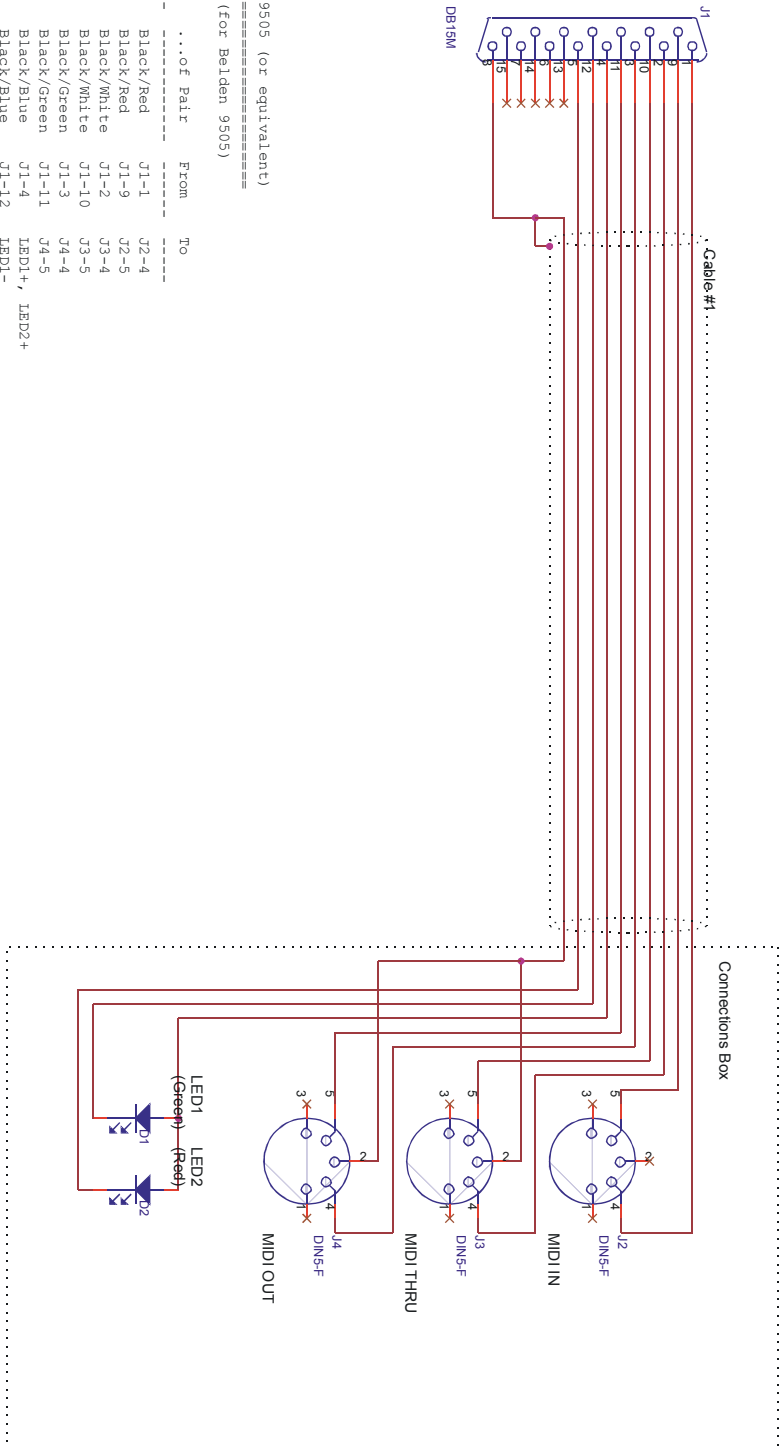Wire assignments (for Belden 9503)

| Signal | Wire | ...of Pair | From | To |
| --- | --- | --- | --- | --- |
| DISP+ | Red | Black/Red | J3-1 | J4-6 |
| DISP+ | Black | Black/Red | J3-1 | J4-6 |
| DISP_TXD | White | Black/White | J3-2 | J4-14 |
| DISP_BSY | Black | Black/White | J3-3 | J4-7 |
| DISP_GND | Green | Black/Green | J3-4 | J4-15 |
| DISP_GND | Green | Black/Green | J3-5 | J4-15 |
| DISP_GND | Black | Black/Green | J3-6 | J4-15 |

AMP-4 and -6 are AMPMODU MTE, Polarized & Latching

AMP-4 is AMP/Tyco P/N 103957-3
AMP-6 is AMP/Tyco P/N 103957-5

Title: CC+ Internal Wiring
Document Number: [Doc]
Size: A4
Rev.

able 1 = Belden 9505 (or equivalent)
============================
ire assignments (for Belden 9505)
============================

| ignal | Wire | ...of Pair | From | To |
|-------|------|-----------|------|-----|
| ----- | ----- | ----- | ----- | ----- |
| IDI_RX+ | Red | Black/Red | J1-1 | J2-4 |
| IDI_RX- | Black | Black/Red | J1-9 | J2-5 |
| IDI_THR+ | White | Black/White | J1-2 | J3-4 |
| IDI_THR- | Black | Black/White | J1-10 | J3-5 |
| IDI_OUT+ | Green | Black/Green | J1-3 | J4-4 |
| IDI_OUT- | Black | Black/Green | J1-11 | J4-5 |
| ED+ | Blue | Black/Blue | J1-4 | LED1+, LED2+ |
| ED+ | Blue | Black/Blue | J1-12 | LED1- |
| ED1 | Yellow | Black/Yellow | J1-5 | LED2- |
| ED2 | Black | Black/Yellow | J1-8 | J3-2, J4-2, SHLD |
| P_GND | Black | | | |

DB15M

J1

Cable #1

Connections Box

LED1 (Green) D1
LED2 (Red) D2

MIDI OUT  DIN5-F  J4
MIDI THRU  DIN5-F  J3
MIDI IN  DIN5-F  J2

Title: CC+ External MIDI Wiring
Size: A4
Document Number: [Doc]
Rev

## **Errata/Functional Discussions**

The following list summarizes any known limitations or restrictions/errata associated with the current (Version 208) firmware release.

- Programming Interface P15 (Param Slider Select) not implemented.
- Volume CC messages are received but not transmitted (Link Balance)
- Both channel and poly pressure commands are received but not transmitted; parameter P16 (pressure) is not yet implemented.
- While the interface is running in expanded MCM mode (P18 = Cust) some MIDI interface parameters change behaviour as follows:
  - P7 Lever 1 Select & P9 Lever 2 Select - only the Pitch Bend setting will be used - any other setting will be overridden by the MCM
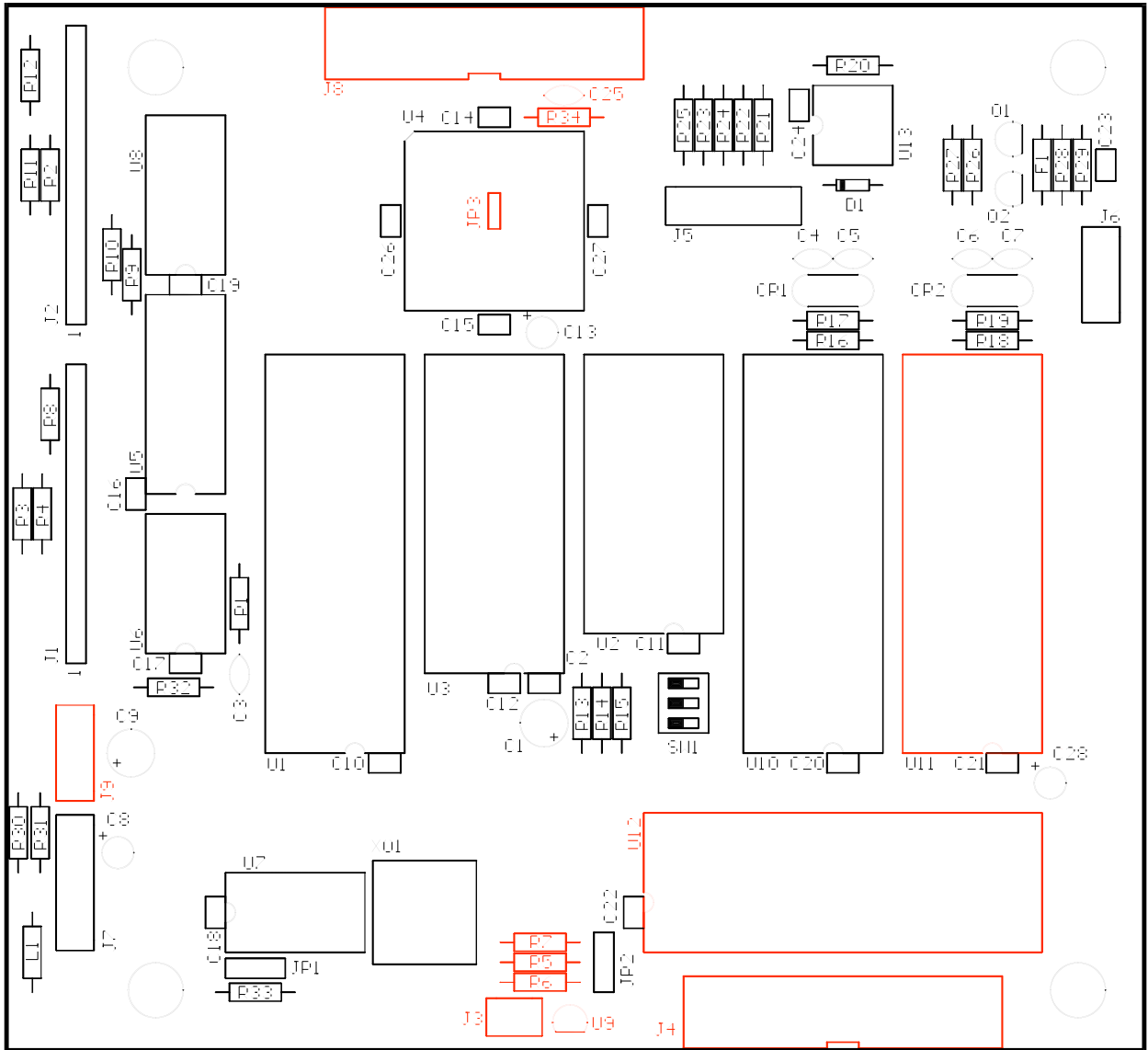  - P11, P12, P13, P14 - overridden by the MCM

## MIDI Connector Assignments/LED Assignments

The drawing below illustrates the port and LED assignments for the external MIDI connector.
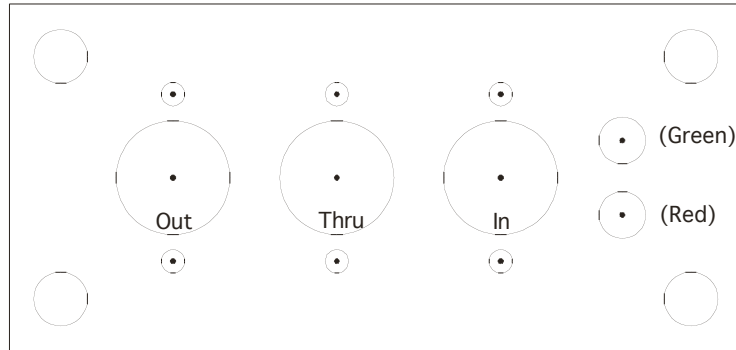


**Figure 21:  Functional Assignments for MIDI Interface Box**

## **Board Outline**



Note - the components shown in RED are intentionally not populated on the Rhodes Chroma/Chroma Expander CC+ board.

◄ **OFF  ON** ►

**DIP SW#1 (On = Delayed Start, Off = Normal Operation)**
**DIP SW#2 (On = DAC Adjust/Service Mode, Off = Normal Operation)**
**DIP SW#3 (Reserved for future use - leave in Off for Normal Operation)**

SW1