Multi-Port MIDI Mapper

## Functions

* Filter  
  Filter MIDI messages based on specific criteria. Filtered messages are not sent to the output.  
  Declare MapEntry that has no output.
* Enable/Disable
  + Global – turn all MIDI mapping on or off
  + Per Output / Map – bypass processing of a specific output
  + Per MapEntry – disable the activation of a MapEntry
  + Per Transform – debug/monitor mode for trouble shooting
* Map/Transform messages
  + 1:1  
    A single incoming MIDI message results in a single output message.
  + 1:n  
    A single incoming MIDI message result in more than one output messages.  
    These output message can be sent all together or in groups at a time (sequencing).
  + n:1  
    Multiple incoming MIDI messages result in a single output message.
  + n:m  
    Multiple incoming MIDI messages result in more than one output message.
* Map/Transform values  
  Transforms an input value to a new output value.
  + Input: Incoming MIDI message / Data Slot / Output of another Transform
  + Transform Function: Constant/Literal/Map/etc.
  + Output: Outgoing message / Data Slot / Input of another Transform
* Map/Transform conditions
  + MapEntries can be turned on/off automatically  
    Transforms that define the state/condition to turn on/off.
  + MapEntries can indicate if other MapEntries should also be considered when matched.
* Control  
  Incoming MIDI messages control the state of the current Patch.
  + Activate a new Patch
  + Enable/Disable parts of the current Patch  
    Map/Output or MapEntries.
* Programming  
  Change the state/settings of the current Patch (and store it at a location)
  + Through the on-board UI
  + Through SysEx (todo)

## Structure

A fast hardware-based Midi mapper that controls multiple output Ports.

A Patch is a definition of settings for routing midi messages from one input to multiple outputs.

Each output has its own Map.

A Map contains Map Entries that Transform Midi messages into one or multiple Midi messages.

Globally 8 data slots are available to store incoming message (parts) in (using a transform). Cleared when Patches are switched/reloaded.

App – DataSlots[8]

App – Patches[10]

Patch – Messages[64]

Patch – MapEntries[12]

MapEntry – Transforms[12]

MapEntry – Messages[1-n] (Patch.Messages)

Transform – TargetMessage (MapEntry.Messages)

## Map Entries

Each Output-Map has several MapEntries that detect messages and perform transformations. One or multiple messages can be constructed. Each MapEntry can also contain a message index of the current message to be sent when in single-message-mode.

Each message can be build using parts of the incoming message and the Data Slots.

* TODO  
  Indicate if to continue processing after a passed message within the output but also between outputs.  
  Allow Map Entries to be turned on and off by Midi input.  
  Power up state of a Map and Sequence.  
  How to change patches using the one MIDI input (program changes/SysEx?)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Detect** | **Transform** | **Dispatch** |
| Program Change | Bank Select # (hi/lo) Program Change # | Param value functions | Bank Select # (hi/lo) Program Change # |
| Control Change | Control # (hi/lo) | Param value functions | Control # (hi/lo) |
| Note On/Off | Note # | Param value functions | Channel Velocity Note # |
| SysEx | Templated | Param value functions | Templated |

### Detection

|  |  |  |
| --- | --- | --- |
| **Type** | **Description** | **Data** |
| Note On/Off | Detect Note messages. |  |
| - Channel |  | Specific, Range or Any |
| - Note # |  | Specific, Range or Any |
| - Velocity |  | Specific, Range or Any |
| Control Change | Detect Control Changes |  |
| - Channel |  | Specific, Range or Any |
| - Control # |  | Specific, Range or Any |
| - Value |  | Specific, Range or Any |
| Program Change | Detect Program Changes |  |
| - Channel |  | Specific, Range or Any |
| - Program # |  | Specific, Range or Any |
| - Value |  | Specific, Range or Any |
| AfterTouch | (Channel Pressure) |  |
| - Channel |  | Specific, Range or Any |
| - Note # | (only for AfterTouch) | Specific, Range or Any |
| - Value |  | Specific, Range or Any |
| Pitch Wheel | Detect Pitch bends |  |
| SysEx | Detect SysEx based on a template |  |
| Common | Detect system common messages | Specific, Range or Any |
| Realtime | Detect System Realtime messages | Specific, Range or Any |

### Transformation

|  |  |  |
| --- | --- | --- |
| **Type** | **Description** | **Data** |
| Literal Value | Value is passed without changing it | 0-127 |
| Value Map | Maps a single value to another value | 0-127 |
| Linear Map | Maps a value range to another value range in a linear way | 0-127 |
| Log Map | Maps a value range to another value range in a logarithmic way | 0-127 |
| [other range maps] | Maps a value range to another value range in “a specific” way | 0-127 |
| Constant Value | Always provides the same value | 0-127 |
| Add Value | Adds a constant to the value | clipped |
| Sub Value | Subtracts a constant from a value | clipped |
|  |  |  |

Transformation functions can be parameterized. These parameters can also be sourced from other information in the same Midi message. Multiple transformations can be defined for one outgoing midi message.

### Dispatcher

The dispatcher builds up a new midi message using the output(s) from the transformation step. The possible message builders are the opposite of the message detectors including parameters.

So for instance a note message can be constructed using a note # and a velocity.

For each midi message type a specific ‘builder’ can be used to make sure all parts of the midi message are provided. These parts can be supplied by transformation functions. Multiple builders –and therefor multiple output midi message- can be used.

## MIDI Out Port Properties

|  |  |  |
| --- | --- | --- |
| **Property** | **Values** | **Description** |
| Enabled | Yes|No | Allow the specific output to be disabled. |
| Running Status | Yes|No | Output short midi messages (running status) |
| Message Time | 0-100 (5) | Time in ms between each MIDI message. |
| Name | Char[8] | Name of the output port. |

## System properties

|  |  |  |
| --- | --- | --- |
| **Property** | **Values** | **Description** |
| SysEx-Recv | Yes|No | Allow the unit to receive Midi SysEx messages. |
| SysEx-Id | 0-127 | A Midi SysEx Device Id. |
| SysExCh | 1-16 | The Midi Channel the SysEx messages are received on. |
| SysMsg-Recv | Yes|No | Allow the unit to receive Midi Program/Control Change messages. |
| SysCh | 1-16 | The Midi Channel system messages are received on (PC) |

## Realtime Screen

At realtime a screen is shown that displays the MIDI activity for the input and the outputs.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |  |
| P | r | e | s | e | t |  | [0 | 1] | [i] |  |  | O | u | t |  | [1] |  |  | O | u | t |  | [2] |  |
| [N | a | m | e | P | r | e | s | e | t] |  |  | O | u | t |  | [3] |  |  | O | u | t |  | [4] |  |

Here a volatile option ‘mode’ is also available allowing to change the mode of operation.

|  |  |
| --- | --- |
| **Mode** | **Description** |
| On | MIDI input is processed with the current Preset. |
| Bypass | All MIDI input is sent to (enabled) MIDI output. |
| Off | MIDI input is ignored and no MIDI is sent to the outputs. |

## User Interface

The user interacts with the device using a small keypad and an LCD display.

### Keypad

For now a total of six key are available.

|  |  |  |
| --- | --- | --- |
| **Key** | **Function** | **Description** |
| L | Left | Navigate left on the display. Either between controls or in textbox between chars. |
| R | Right | Navigate right on the display. Either between controls or in textbox between chars. |
| U | Up | Navigate up on the display. This can move the display to another line if not visible and if context allows. |
| D | Down | Navigate down on the display. This can move the display to another line if not visible and if context allows. |
| E | Enter | Enter the current ‘location’ or control. This usually puts the control in edit-mode. |
| X | Exit / Cancel | Exit the edit-mode or cancel the current state or context and go back to navigation mode. |

### Screens

Generic Display Layout

Line1: Menu breadcrumb path (static) – no navigation/keys  
Line2: Current Menu Option (dynamic)

U/D navigates through the menu options of that level –or- navigate through the instances of that object.  
< at start and > at end indicate more side options (only on the final option page).  
E enters into that option descending one level.  
X leaves the level ascending one level.

Menu Hierarchy

|  |  |  |  |
| --- | --- | --- | --- |
| **Page** | **Navigation** |  |  |
| System | X -> Preset Page |  |  |
| Preset | X -> System Page |  |  |
|  | U/D Selects presets |  |  |
|  | R -> Edit Preset Name |  |  |
|  | E -> Map Entry |  |  |
| Map Entry | X -> Preset Page |  |  |
|  | U/D Select Map Entries |  |  |
|  | L/R -> Msg Type, Identifier, Value |  |  |
|  | E -> Messages |  |  |
| - Msg Type | X -> Map Entry Page |  |  |
|  | R -> Identifier |  |  |
| - Identifier | X -> Map Entry Page |  |  |
|  | R -> Value |  |  |
| - Value | X -> Map Entry Page |  |  |
|  | R -> Msg Type |  |  |
| Messages | X -> Map Entry Page |  |  |
|  | U/D Select Messages |  |  |
|  |  |  |  |
| Transform |  |  |  |
|  | U/D |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Screen** | **Part** | **Keys** | **Description** |
| Splash | - | - | Shown during startup. Then Preset. |
| Preset |  | L/R and U/D -> Navigate parts.  E -> Selects a part.  X -> Go to System Settings Screen. |  |
|  | Preset Number | U/D -> Step through Presets  E -> Loads selected Preset  X -> Cancel Preset selection | The current selected Preset. |
|  | Name | L/R -> navigates chars.  U/D -> Changes current char. | Name of the Preset. |
|  | MIDI Out Port | E -> Select Map Entry | Map for each MIDI output (4x). |
| Map Entry |  | L/R and U/D -> Navigate parts.  E -> Selects a part.  X -> Go to Preset Screen. |  |
|  | Entry Number | U/D -> Step through Entries | Shows detection settings for the selected entry. |
|  | Message Type | U/D -> Step through MIDI message types. | MIDI in filter/detection setting. |
|  | Identifier | U/D -> Select MsgType specific Identifier. | May be disabled based on Message Type. |
|  | Value | U/D -> Ramp 0-127 | May be disabled based on Message Type. |
| Output Message |  |  | Show the message that are output. |
| Transform |  | L/R and U/D -> Navigate parts.  E -> Selects a part.  X -> Go to Map Entry Screen. | Transformations applied to build the Output Message. |
|  |  |  |  |
| System Settings |  | L/R and U/D -> Navigate parts.  E -> Selects a part.  X -> Go to Preset Screen. |  |
|  | MIDI | E -> Enter Out Settings. |  |
| Out Settings |  | L/R and U/D -> Navigate parts.  E -> Selects a part.  X -> Go to Preset Screen. |  |
|  | Enable |  | Enable/Disable MIDI output. |
|  | Running Status |  | Use Running Status when sending MIDI messages? |
|  | Min. Time |  | Minimum time between MIDI messages. |

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#### Splash

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | M | I | D | I |  | M | a | s | t | e | r |  | v | 0 | . | 1 |  |  |  |  |  |
| ( | C | ) |  | C | a | n | n | e | d |  | B | y | t | e | s |  |  |  |  | 2 | 0 | 1 | 7 |  |

#### Realtime

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P | r | e | s | e | t |  | [0 | 1] | [i] |  |  | O | u | t |  | [1] |  |  | O | u | t |  | [2] |  |
| [N | a | m | e | P | r | e | s | e | t] |  |  | O | u | t |  | [3] |  |  | O | u | t |  | [4] |  |

|  |  |  |
| --- | --- | --- |
| **Part** | **Control** | **Description** |
| Preset | Label | ‘Preset’ |
| [01] | NumUpDown | Selects current Preset.  Loads on E. Reverts on X. |
| [i] | Label | ‘o’ Shown when detecting MIDI input. |
| [NamePreset] | TextBox | Edit Name of Preset. |
| Out | Label | ‘Out’ |
| [n] (1-4) | NavLabel | ‘o’ Shown when detecting MIDI output.  Navigates to Map Entry Screen on E. |

Alternative?

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |  |
| [0 | 1] | : | [N | a | m | e | O | f | P | a | t | c | h | . | . | . | . | .] | [\*] | [M] | [i] |  |  |  |
| [O | u | t | 1] |  |  | [O | u | t | 2] |  |  | [O | u | t | 3] |  |  | [O | u | t | 4] |  |  |  |

|  |  |  |
| --- | --- | --- |
| **Part** | **Control** | **Description** |
| [01] | NumUpDown | Selects current Patch.  Loads on E. Reverts on X. |
| [NameOfPatch] | TextBox | Edit Name of Patch. |
| [\*] | Label | ‘\*’ Shown when the Patch has unsaved edits. |
| [M] | SelectMode | Selects mode:  ‘o’ => Patch On  ‘=’ => Bypass Maps  ‘x’ => All Off |
| [i] | Label | ‘o’ Shown when detecting MIDI input. |
| [OutX] (1-4) | OutNavLabel | ‘o’ when detecting MIDI output.  ‘[n]’ active map entry when MIDI is transformed.  ‘-’ when disabled  Navigates to Map Entry Screen on E.  Short custom Output names (4 or 5 chars). |

#### Map Entry

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E | n | t | r | y |  | [0 | 1] |  |  | O | u | t |  | [x | \* | \* | \* | \* | \* | \* | \* | \* | \*] |  |
| M | s | g |  | [C | C] |  | I | d | e | n | t |  | [1 | 2 | 7] |  | V | a | l |  | [1 | 2 | 7] |  |

|  |  |  |
| --- | --- | --- |
| **Part** | **Control** | **Description** |
| Entry | Label | ‘Entry’ |
| [01] | [NumUpDown] | Selects the Map Entry. |
|  |  |  |
| Msg | Label | ‘Msg’ |
| [Prog Change] | TextUpDown | List of possible MIDI messages.  Note (Nt)  AfterTouch (AT)  ControlChange (CC)  ProgramChange (PC)  PitchBend (PB)  SystemCommon (SC)  RealTime (RT)  SysEx (SE) |
| Id | Label | ‘’ Identifier |
| [] | TextBox | Identifier value (can be disabled) |
| Val | Label | ‘Val’ |
| [127] | TextBox | Value (0-127) (can be disabled) |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## Schematic

The device will initially start out with 1 Midi input 4 Midi outputs.

## Midi Implementation

The Midi implementation for the device itself (not the mapper) is displayed in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Midi Message** | **Transmitted** | **Received** | **Remarks** |
| Note on/off | No | No | Ignored |
| Control Change | No | No | Ignored |
| Program Change | Yes | Yes | Patch select. Can be disabled. |
| Real Time | No | No | Ignored |
| SysEx | Yes | Yes | Bulk import/export. |

## Bill Of Materials

|  |  |  |
| --- | --- | --- |
| **#** | **Name** | **Link** |
| 6 | Midi Socket | <http://nl.farnell.com/pro-signal/psg03463/din-socket-pcb-5p-180deg/dp/1791756> |
| 1 | CNY17 Opto coupler | <http://nl.farnell.com/isocom/cny17f-4x/optocoupler-dip-6-tr-o-p/dp/1683185> |
| ~~1~~ | ~~LCD 2x20 Display~~ | [~~http://nl.farnell.com/powertip/pc2002lrs-awa-b-q/lcd-module-20x2-led-b-l/dp/1671504~~](http://nl.farnell.com/powertip/pc2002lrs-awa-b-q/lcd-module-20x2-led-b-l/dp/1671504) |
| 1 | LCD 2x24 Display | <http://nl.farnell.com/midas/mc22405c6wk-sptly/lcd-2x24-stn-ylw-green-b-l-5mm/dp/2063254> |
| 2 | 74LS07N | <http://nl.farnell.com/texas-instruments/sn74ls07n/ic-buffer-driver-receiver/dp/1470756> |
| 2 | 74HC595N | <http://nl.farnell.com/nxp/74hc595n/ic-74hc-cmos-74hc595-dip16-5v/dp/3166028> |
| 12 | 1N4148 | <http://nl.farnell.com/multicomp/1n4148/diode-do-35-100v-150ma/dp/9565124> |
| 18 | 220 ohm | <http://nl.farnell.com/multicomp/mcf-0-25w-220r/resistor-220r-0-25w-5/dp/9339299> |
| 1 | Trimmer 10k | <http://nl.farnell.com/te-connectivity-citec/cb10lh103m/trimmer-side-adjust-10k/dp/1227524> |
| 4 | 100nF capacitor | <http://nl.farnell.com/vishay/a104k15x7rh5taav/capacitor-axial-100v-100nf/dp/1902257> |
| 1 | 24LC256 I2C EEPROM | <http://nl.farnell.com/microchip/24lc256-i-p/eeprom-serial-256k-24lc256-dip8/dp/9757970> |

## Resources

### USB – MIDI

Roland Serial to MIDI Driver

<http://www.usb.org/developers/devclass_docs/midi10.pdf>

<http://forum.arduino.cc/index.php?topic=22047.0>