

MIDI support in piHPSDR

Manual for Users

To use MIDI devices in piHPSDR, you must provide a text file `midi.inp` that resides in the current working dir of piHPSDR (that is, where the `"*.props"` file and the WDSP wisdom files also reside).

A sample `midi.inp` file for the popular Behringer "CMD PL-1" MIDI console is provided as an example. The basic rules for the file are

- the file is line-oriented. Each line contains a directive
- in each line, a `"#"` sign denotes a comment, that is: a line beginning with a `"#"` is skipped completely, and in all other lines, the `"#"` and all following characters are skipped.
- There must be at least one line starting with `"DEVICE="`. Everything following the `"="` is treated as the device name (without trailing blanks). Only MIDI devices are accepted whose name starts with the given device name. for example, a line reading `"DEVICE=CMD PL"` will accept the "CMD PL-1" MIDI controller.
- Lines not specifying a device must contain one (and only one) of the strings `"KEY="`, `"CTRL="`, or `"PITCH"`.
- The lines then can contain additional key words which are as follows

```
ONOFF
WHEEL
CHAN=<chan>
ACTION=<action>
THR=<thresholds>
DELAY=<delay>
```

where `<chan>` is a MIDI channel number (1–16), `<action>` is a key word which tells which action should be triggered (see below), `<delay>` is a delay (in milli seconds) which may be applied to WHEELs (see below), and `<thresholds>` is a list of **twelve** integer values which are used to translate the low-level values reported by a wheel into one of the six cases up/down combined with normal/fast/very fast. All these key words are optional, the default values are

<code><chan>=0</code>	this means AnyChannel, see below
<code><action>=NONE</code>	in this case the whole line has no meaning
<code><thr>=128 -1 128 -1 128 -1 128 -1 128 -1</code>	
<code><delay>=0</code>	no delay enforced

MIDI channels

If the CHAN keyword is not there, or a value for `<chan>` is given that is smaller than 1 or larger than 16, then a MIDI message from any channel triggers the event specified. If the line includes, say, `"CHAN=5"`, then only MIDI messages from channel 5 triggers the event specified in the line. The CHAN key word is there for future extensions, if more than one MIDI controller can be used.

KEY events: MIDI push buttons

MIDI KEYS generate NoteOn/NoteOff messages. They are usually generated by push-buttons on the MIDI controller. Normally the action will only be executed when pressing the key, but if the additional key word ONOFF is given, the action will be executed both when pressing and releasing the key.

Example. If the TUNE (toggle TUNE state) is associated with a push-button, then in the normal case, the radio will start tuning when pressing the button, and stop tuning when pressing it again at a later time (in between, you may go to your antenna coupler and adjust it). However when the ONOFF key word is given, the radio will start tuning when pressing (and holding) the button, and stop tuning when releasing the button.

CTRL events: MIDI controllers (knobs and wheels)

For music instruments, MIDI controllers are expression pedals etc., they send values in the range 0–127. We distinguish between "knobs" and "wheels". Knobs can be turned left or right until one meets an end point, and send values from 0 to 127 indicating where we are between the left and right extreme. Knobs can typically be used for adjusting AF and microphone level, the TX drive level, etc. So the line

CTRL=20 ACTION=RFPOWER

will use the MIDI controller with id=20 (0x14) to adjust the TX drive level, which is minimal when the knob is turned fully counter-clockwise and maximal if the knob is turned fully clockwise.

A wheel is a special type of MIDI controller. It has no fully (counter-) clockwise position, but instead can be turned either left or right without ever stopping. While being rotated, it constantly sends MIDI messages encoding the sense (left/right) and possibly the speed of rotation. Wheels can also be used, say, to set the AF volume. The software automatically takes care that if the minimum (maximum) value is reached, further rotation has no effect. Wheels need the additional keyword THR to translate controller values into one of the six cases

very fast left
fast left
left
right
fast right
very fast right

If $t_1, t_2, \dots, t_{11}, t_{12}$ are the twelve integer values following "THR=", then the algorithm for converting MIDI controller values into one of the six cases is as follows:

$t_1 \leq \text{value} \leq t_2$	==> very fast left
$t_3 < \text{value} \leq t_4$	==> fast left
$t_5 < \text{value} \leq t_6$	==> left
$t_7 \leq \text{value} \leq t_8$	==> right
$t_9 \leq \text{value} \leq t_{10}$	==> fast right
$t_{11} \leq \text{value} \leq t_{12}$	==> very fast right

From this it follows that if, for example, the "very fast left" case should never be triggered, choose thresholds such that $t_2 > t_1$. Such "dummy" threshold values have to be specified if e.g. the wheel is not speed sensitive such that only the "left" and "right" cases can be triggered. This also means that using the default thresholds for a "wheel" an action will never be triggered.

The "standard" use for wheels are VFO knobs, but they can also be used in all cases where knobs can be used. It may happen that when turning a wheel, the MIDI messages are generated at such a fast rate that it is difficult, e.g., to adjust the TX drive level to a desired value. Here the DELAY keyword helps. It specifies a delay (in milli seconds) during which further MIDI controller messages are ignored. Specifying, for example DELAY=100 for a wheel where ACTION=RFPOWER, this implies that the TX drive level (which is between 0 and 100) changes at most by 10 units per second if the corresponding wheel is turned.

PITCH events: MIDI PITCH bends

Some MIDI controllers have a pitch controller. There can at most be one pitch controller per MIDI channel, and the MIDI protocol specifies that it can encode values from 0 to 16383. To give an example, the line

PITCH ACTION=AFGAIN

indicates that the AF volume level should be controlled with the pitch controller. Functionally, a pitch controller is fully equivalent to a knob, since it has a minimum and a maximum value.

List of Actions

The following table documents which MIDI actions are available (in alphabetical order). Some actions require a special case of MIDI event: it makes no sense to control the VFO frequency using a push-button. We will designate by "knob" either a MIDI controller without the "WHEEL" key word or a MIDI pitch controller, by "wheel" a MIDI controller with the "WHEEL" key word and by "key" a MIDI key.

In order not to overload the user interface, we have no action "go to 20m band". Instead, we implement a "band up" and "band down" action. With a push-button, you may cycle through the bands 160m - 80m - 60m etc, while with another push-button you may cycle the other way round. It is also possible to assign both "band-up" and "band-down" to a wheel, then turning the wheel in either direction will cycle through the bands in either direction. This is also possible for filter sizes and modes.

Sometimes the same keyword may have a different meaning if combined with a key or with a knob: for example, the ATT key word combined with a key cycles through the ALEX attenuator settings (0 dB, 10 dB, 20 dB, 30 dB), while ATT combined with a knob or with a wheel changes the value of the step-attenuator (0–31 dB in 1 dB steps).

Action key word	Valid elements	Description
AFGAIN	knob, wheel	set AF volume level
AGC	knob, wheel	change AGC value
AGCATTACK	key	cycle through AGC attack (fast/med/slow)
ATT	key	cycle through ALEX attenuator settings
ATT	wheel, knob	set value of step attenuator
BANDDOWN	key, wheel, knob	cycle through bands downwards
BANDUP	key, wheel, knob	cycle through bands upwards
COMPRESS	wheel, knob	set TX compression value
CTUN	key	toggle CTUN mode
FILTERDOWN	key, wheel, knob	cycle through filters downwards
FILTERUP	key, wheel, knob	cycle through filters upwards
LOCK	key	toggle LOCK on/off
MICGAIN	knob, wheel	change microphone gain
MODEDOWN	key, wheel, knob	cycle through modes downwards
MODEUP	key, wheel, knob	cycle through modes upwards
MOX	key	toggle MOX state
NOISEBLANKER	key	cycle through NB settings
NOISEREDUCTION	key	cycle through NR settings
PANHIGH	wheel, knob	change "high" value of current panadapter
PANLOW	wheel, knob	change "low" value of current panadapter
PREAMP	key	cycle through preamp settings ^{a)}
PURESIGNAL	key	toggle PURESIGNAL enable/disable
RFPOWER	knob, wheel	change TX drive level
RIT	key	toggle RIT on/off
RITSTEP	key, wheel	
RITVAL	wheel, knob	change RIT value
SPLIT	key	toggle SPLIT enable/disable
SWAPVFO	key	swap VFOs A and B
SWAPRX	key	toggle between RX0 and RX1
TUNE	key	toggle TUNE state
VFO	wheel	change frequency of current VFO
VFOA	wheel	change frequency of VFO A
VFOB	wheel	change frequency of VFO B
VFO_A2B	key	copy frequency from VFO A to VFO B
VFO_B2A	key	copy frequency from VFO B to VFO A
VFOSTEPUP	key, wheel	increase VFO step size
VFOSTEPDOWN	key, wheel	decrease VFO step size
VOX	key	toggle VOX enable/disable
NONE	key, knob, wheel	no action

^{a)} preamps only available for CHARLY25 filter board

Some functions come in pairs, such as **BANDUP** and **BANDDOWN**. They can be mapped to separate keys, but when using a wheel or a knob, it is only necessary to assign one of these two functions. The same applies to **FILTERUP/FILTERDOWN**, **MODEUP/MODEDOWN**, **VFOSTEPUP/VFOSTEPDOWN**.

Appendix A. Sample midi.inp file for a Behringer CMD PL-1 controller

The file is given in a small font to avoid line breaks. Use copy+paste to get this onto you computer.

```
#
# Sample midi.inp file, suitable for a Behringer CMD PL-1 MIDI controller
#
# Note that the Attenuator is implemented twice, as a key and as a wheel
# The key is suitable for radios with a step (ALEX) attenuator, the wheel
# fits best for radios with a programmable attenuator (0-31 dB).
#
DEVICE=CMD PL-1
#
# Big Wheel: main VFO knob
# Note that there is a "KEY" event (id=31) triggered by pushing the VFO wheel.
# Ignore this, because this happens unintentionally most of the time you
# use the wheel.
#
CTRL=31 WHEEL THR=0 59 60 61 62 63 65 66 67 68 69 127 ACTION=VFO
KEY=31 ACTION=NONE
#
# Big slider (pitch-bend controller): AF volume
#
PITCH ACTION=AFGAIN
#
# 8 Knobs (top left). These are "wheels" assigned to
#
# id=0: top row, leftmost: StepAttenuator
# id=1: top row, 2nd from left: TX compression
# id=2: top row, 2nd from right: RIT value
# id=3: top row, rightmost: Panadapter low
# id=4: bottom row, leftmost: AGC value
# id=5: bottom row, 2nd from left: MIC gain
# id=6: bottom row, 2nd from right: TX drive
# id=7: bottom row, rightmost: cycle through filters
#
CTRL=0 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=ATT
CTRL=1 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=COMPRESS
CTRL=2 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=RITVAL
CTRL=3 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=PANLOW
CTRL=4 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=AGC
CTRL=5 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=MICGAIN
CTRL=6 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=RFPOWER
CTRL=7 WHEEL THR=-1 -1 -1 -1 1 63 65 127 128 128 128 128 ACTION=FILTERUP
#
# Push actions on these knobs generate KEY events are are not assigned
#
KEY=0 ACTION=NONE
KEY=1 ACTION=NONE
KEY=2 ACTION=NONE
KEY=3 ACTION=NONE
KEY=4 ACTION=NONE
KEY=5 ACTION=NONE
KEY=6 ACTION=NONE
KEY=7 ACTION=NONE
#
# 8 Keys (below the 8 Knobs)
#
# id=16 label="1": top row, leftmost: not assigned
# id=17 label="2": top row, 2nd from left: cycle through Alex ATT settings
# id=18 label="3": top row, 2nd from right: clear RIT value and turn off RIT
# id=19 label="4": top row, rightmost: toggle CTUN
# id=20 label="5": bottom row, leftmost: cycle through noise blanker settings
# id=21 label="6": bottom row, 2nd from left: cycle through noise reduction settings
# id=22 label="7": bottom row, 2nd from right: toggle VOX
# id=23 label="8": bottom row, rightmost: cycle through AGC fast/medium/slow
```

```

#
KEY=16 ACTION=NONE
KEY=17 ACTION=ATT
KEY=18 ACTION=RIT
KEY=19 ACTION=CTUN
KEY=20 ACTION=NOISEBLANKER
KEY=21 ACTION=NOISEREDUCTION
KEY=22 ACTION=VOX
KEY=23 ACTION=AGCATTACK
#
# "other" keys
# Note that the "DECK" key switches the MIDI channel of the device.
#
KEY=24 ACTION=TUNE           # LOAD   button: TUNE on/off
KEY=25 ACTION=LOCK           # LOCK   button: Lock VFO(s)
KEY=26 ACTION=PURESIGNAL     # DECK   button: toggle PURSIGNAL
KEY=27 ACTION=SWAPVFO        # SCRATCH button: Swap VFOs A and B
KEY=32 ACTION=VFOA2B         # SYNC   button: Frequency VFO A -> VFO B
KEY=33 ACTION=VFOB2A         # TAP    button: Frequency VFO B -> VFO A
KEY=34 ACTION=MOX            # CUE    button: MOX on/off
KEY=35 ACTION=SPLIT          # >||    button: toggle Split
KEY=36 ACTION=MODEDOWN       # <<     button: Mode down
KEY=37 ACTION=MODEUP         # >>     button: Mode up
KEY=38 ACTION=BANDDOWN       # -      button: Band down
KEY=39 ACTION=BANDUP         # +      button: Band up

```

Appendix B. Sample midi.inp file for a Behringer CMD Studio2a controller

```
#
# Sample midi.inp file, suitable for a Behringer CMD Studio2a MIDI controller
#
DEVICE=Studio 2A
#
# Left Big Wheel: VFO knob for active receiver
#
CTRL=3 WHEEL THR=0 59 60 61 62 63 65 66 67 68 69 127 ACTION=VFO
#
# Left big vertical slider: AF Gain
#
CTRL=24 ACTION=AFGAIN
#
KEY=1 ACTION=MOX # Key Cue
KEY=2 ACTION=SPLIT # Key >||
KEY=2 ACTION=LOCK # Key Sync
KEY=6 ACTION=BANDDOWN # Key -
KEY=7 ACTION=BANDUP # Key +
KEY=8 ACTION=VFOSTEPUP # Key A
KEY=9 ACTION=VFOSTEPDOWN # Key B
KEY=10 ACTION=MODEUP # Key 1
KEY=11 ACTION=MODEDOWN # Key 2
KEY=12 ACTION=FILTERUP # Key 3
KEY=13 ACTION=FILTERDOWN # Key 4
KEY=14 ACTION=VFOA2B # Key 1
KEY=15 ACTION=VFOB2A # Key 2
KEY=17 ACTION=SWAPVFO # Key 3
KEY=18 ACTION=FILTERDOWN # Key 4
```

Appendix C. Sample midi.inp file for a Hercules DJ compact controller

```
# Hercules DJControl Compact HerculesDJ-midi.inp file.
# This file contains Control and key numbers specific
# to the Hercules DJContoller Compact device

# Rename this file to midi.inp and place in the folder where piHPSDR stores
# its settings (*.props files) and the WDSP wisdom file.
# Restart pihpsdr to incorporate settings included in this file.

# THE # Character indicates following text is a comment, not actionable instructions.
# Actions not commented out (No # letter at start of line) must be assigned.

DEVICE=DJControlCompact

# DJControl includes 2 large wheels which are assigned to VFO's

# Left wheel, VFOA increasing freq when rotated to right
CTRL=48 WHEEL THR=-1 -1 -1 -1 64 127 1 63 -1 -1 -1 -1 ACTION=VFOA
# Shift Key, Left wheel, VFOA increasing freq when rotated to right
CTRL=55 WHEEL THR=-1 -1 -1 -1 64 127 1 63 -1 -1 -1 -1 ACTION=VFOA

# Reverse VFO frequency rotation example:
# Left wheel, VFOA decreasing frequency when rotated to right.
# CTRL=48 WHEEL THR=-1 -1 -1 -1 1 63 64 127 128 128 128 128 ACTION=VFOA

# Right wheel, VFOB increasing frequency when rotated to right
CTRL=49 WHEEL THR=-1 -1 -1 -1 64 127 1 63 -1 -1 -1 -1 ACTION=VFOB
# Shift Key, Right wheel, VFOB increasing frequency when rotated to right
CTRL=56 WHEEL THR=-1 -1 -1 -1 64 127 1 63 -1 -1 -1 -1 ACTION=VFOB

#Knobs or sliders
CTRL=54 ACTION=AFGAIN           # Slider, bottom center, Selected RX AF gain
CTRL=57 ACTION=RFPOWER          # Left volume : RF Drive,
CTRL=59 ACTION=MICGAIN          # Left Medium
CTRL=60 ACTION=AGC              # Left Bass, Selected Receiver AGC gain
CTRL=61 ACTION=ATT              # Right Volume, button only for Alex, else knobs etc,
#CTRL=63 ACTION=NONE            # Right Medium
#CTRL=64 ACTION=NONE            # Right Bass

# Buttons
# There are two 4-button pads bottom center left and right. Additional 4 button pads
# can be virtually selected by holding down the MODE button and pressing 1,2,3 or 4
# on the left or right pads.
# The selected pad is indicated by illuminating the Loop, FX, Sample or Cue light
# above the pad.

# Left Cue (Press Mode,4 (lower right button) to access pad button 1-4
KEY=1 ACTION=SPLIT              # Cue P1 button: toggle Split
KEY=2 ACTION=ATT                # BUTTON FOR ALEX ATT
KEY=3 ACTION=MOX                # Cue P3 button: MOX on/off
KEY=4 ACTION=TUNE               # Cue P4 button: TUNE on/off

# Right Cue (Press Mode,4 (lower right button) to access pad button 1-4
KEY=49 ACTION=VFOSTEPUP         # Cue P1 button: VFO step size up
KEY=50 ACTION=VFOSTEPDOWN       # Cue P2 button: VFO step size down
KEY=51 ACTION=BANDUP            # Cue P3 button: Band up
KEY=52 ACTION=BANDDOWN          # Cue P4 button: Band dn

# Left Sample (Press Mode,3 (lower left button) to access pad button 1-4
KEY=17 ACTION=NONE              # Sample P1 button:
KEY=18 ACTION=NONE              # Sample P2 button:
KEY=19 ACTION=NONE              # Sample P3 button:
KEY=20 ACTION=NONE              # Sample P4 button:
```



```

# Right Sample (Press Mode,3 (lower left button) to access pad button 1-4
KEY=65 ACTION=NONE          # Sample P1 button:
KEY=66 ACTION=NONE          # Sample P2 button:
KEY=67 ACTION=NONE          # Sample P3 button:
KEY=68 ACTION=NONE          # Sample P4 button:

# Left FX (Press Mode,2 (Upper right button) to access pad button 1-4
#KEY=9 ACTION=NONE          # FX P1 button:
#KEY=10 ACTION=NONE         # FX P2 button:
#KEY=11 ACTION=NONE         # FX P3 button:
#KEY=12 ACTION=NONE         # FX P4 button:

# Right FX (Press Mode,2 (Upper right button) to access pad button 1-4
KEY=57 ACTION=NONE          # FX P1 button:
KEY=58 ACTION=NONE          # FX P2 button:
KEY=59 ACTION=NONE          # FX P3 button:
KEY=60 ACTION=NONE          # FX P4 button:

# Left Loop (Press Mode,1 (Upper left button) to access pad button 1-4
KEY=25 ACTION=NONE          # Loop P1 button:
KEY=26 ACTION=NONE          # Loop P2 button:
KEY=27 ACTION=NONE          # Loop P3 button:
KEY=28 ACTION=NONE          # Loop P4 button:

# Right Loop (Press Mode,1 (Upper left button) to access pad button 1-4
KEY=73 ACTION=NONE          # Loop P1 button:
KEY=74 ACTION=NONE          # Loop P2 button:
KEY=75 ACTION=NONE          # Loop P3 button:
KEY=76 ACTION=NONE          # Loop P4 button:

# Buttons under left wheel
#KEY=33 ACTION=SWAPVFO      # -> play btn
KEY=34 ACTION=VFOB2A        # Cue btn
KEY=35 ACTION=VFOA          # Sync btn under

# Buttons under right wheel
#KEY=81 ACTION=VFOB         # -> play btn
KEY=82 ACTION=VFOA2B        # Cue Btn
KEY=83 ACTION=SWAPVFO       # Sync btn

# Buttons above pads
KEY=43 ACTION=NOISEREDUCTION # Rec btn. Toggle NR, NR1, NR2
KEY=45 ACTION=NOISEBLANKER   # Scratch/AutoMix btn.

```