Q174 MIDI Interface

Oct 2013

The Q174 MIDI Interface module accepts MIDI data from a keyboard, computer or other device and produces Pitch, Gate and other signals needed to control the synthesizer.

Three modes of operation offer a variety of outputs for one or two MIDI channels. Outputs include standard 1V/Octave Pitch outputs with 10-octave ranges, 5V Gates, Trigger pulse, On and Off Velocity, Channel Pressure and several Continuous Controller outputs.

Complete control over Note Priority and Gate modes provide virtually any type of keyboard response emulating virtually all vintage and modern keyboards along with some that are unique.

Specifications

Panel Size: Single width 2.125"w x 8.75"h.
Pitch Outputs: 1V/Octave, 10-octave range.
Velocity Outputs: 0-5V.
Gate Outputs: 5V positive.
Trigger Output: 5V positive, 5ms.
Channel Pressure Output: 0-5V.
MIDI Pitch Bend: Affects Pitch output +/- 2 semitones.
Pitch Add Input: External voltage added to Pitch.
CC Outputs: CC1(analog 0-5V), CC7(analog 0-5V), CC4(digital 0-5V).
MIDI Channel #: Jumper-selectable to 1, 3, 5 or 7.
Latency: < 1.5ms.
Gate Modes: Single, Multiple, Multiple+Release.
Note Priority: Last, Low, High.
Power: +15V@30ma, -15V@30ma, +5V@50ma.

Modes

The mode switch determines the function of the outputs in the middle section of the module. Regardless of the mode, data from the first MIDI channel produces signals in the top section. Gate and Priority switches are in effect in all modes.

Mode 1
Full-featured single-channel operation. Produces Channel Pressure voltage, Off Velocity voltage and a Trigger Pulse for one MIDI channel.

Mode 2
Dual-channel operation with Pitch, Velocity and Gate signals produced for two MIDI channels (the selected channel and the selected channel + 1). Incoming MIDI Pitch Bend messages are assigned to their corresponding Pitch outputs.

Mode 3
Generates analog voltages from Continuous Controller Messages #1 and #7, along with an On/Off Gate signal from #4. These can be used to control filters, start sequencers, trigger envelope generators, etc.

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MIDI Input
(channel selectable)

Pitch Output
10-octave range
with MIDI Pitch Bend

Velocity Output
5 volt range

Mode switch determines
function of the 3 outputs
in the middle section

Gate Mode
Complete control over
how Gates are produced
when multiple keys
are pressed

Voltage input here
is added to the
Pitch voltage

Gate Output
5 volt positive

Mode 1
Extended features
for channel 1.

Mode 2
A second MIDI channel
Pitch, Velocity, Gate

Mode 3
Continuous Controller
messages

Note Priority
Complete control over
how note (pitch voltages)
are produced when
multiple keys are pressed

Gate Mode Switch

Determines how Gate signals are produced when multiple keys are pressed.

Single - A new Gate signal is produced only when a key is pressed and no other keys are pressed. The Gate will stay On as additional keys are pressed. This is how a MiniMoog and some other synthesizers operate. In this mode, fast playing with overlapping notes will not produce new envelope cycles for each new key pressed, only the first.

Multiple - A new Gate signal is produced each time a new key is pressed, even if other keys are being pressed simultaneously. This new Gate is generated by turning the Gate Off for a very short period of time, then back On. New Gates will retrigger envelope generators as each key is pressed regardless of the number of keys being held down.

Multiple+Release - This is the same as the Multiple setting but with a new Gate also being produced when a key is released. This allows for fast trills and is a feature of some vintage synthesizers.

Note Priority Switch

Determines how Pitch voltages are created when multiple keys are pressed.

Last - The last note played determines the voltage at the Pitch output. This provides a very intuitive keyboard response. Regardless of the direction that your note sequence is played, the most recent note is produced at the Pitch output. If a note is released while other notes are being held, then the highest note being held will play. This behavior can be changed by issuing a MIDI CC14 message. CC14 value <64 selects the behavior just described, CC14 value >63 selects Last note only behavior where releasing notes while others are held does not change the note being played.

Low - The lowest note being played determines the voltage at the Pitch output. This is how a MiniMoog and the Moog modular systems operate.

High - The highest note being played determines the voltage at the Pitch output. This is how some vintage synthesizers from Japan operate.

Add-In Input

Voltages patched into this input are added to the voltage at the Pitch output. This allows transposing using a sequencer, vibrato from oscillators, merging of other controllers, etc. If a plug is inserted into the Add-in input, it must be connected to a voltage source to operate properly, not left open or disconnected.

Off Velocity Output

The MIDI specification provides for an Off Velocity in each Note Off message. For a keyboard instrument, this would be the speed at which a key is released. Many instruments do not send an Off Velocity signal, but for those that do, this voltage could be used to control filters and other module parameters.

CC (Continuous Controller) Outputs

Continuous Controllers are MIDI signals typically produced by knobs, pedals and buttons. In mode 3, the Q174 will produce voltages for three MIDI CC messages -

CC 1 is typically the modulation wheel of a keyboard system (0-5 volts continuous)
CC 7 is predefined as a volume control (0-5 volts continuous)
CC 4 is predefined as a foot switch controller (0 or 5 volts digital like a gate)

Use these voltages to control any parameter of the synthesizer.

Channel Pressure Output

Some keyboards produce Channel Pressure on the MIDI data stream. Pressing the keys hard produces Channel Pressure messages. This is a monophonic response - all keys produce the same message. In Mode 1, a voltage will be produced at the Pressure output that tracks Channel Pressure. In practical application, Channel Pressure tends to be non-linear, of limited range and varies between keyboards depending upon the sensor used.

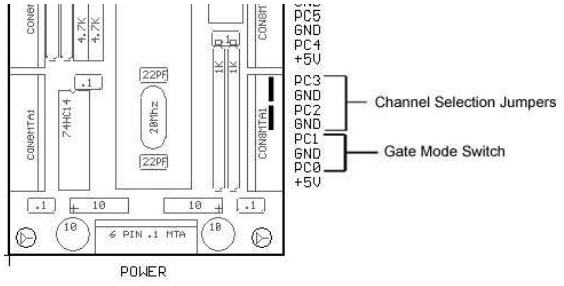
MIDI Channel Selection

Jumpers on the circuit board give the Q174 four MIDI channel settings - 1, 3, 5 and 7.

In Mode 2 the output jacks in the middle section respond to the selected channel+1. So, if the channel setting jumpers are set to channel 1 (the factory default), then the jacks in the middle section will respond to data from MIDI channel 2.

There are 2 jumpers that set the MIDI channel # - see the drawing. Viewing the circuit board with the Power connector at the bottom, you will see 2 jumpers.

Top jumper On, bottom jumper On = Channel 1
Top jumper Off, bottom jumper On = Channel 3.
Top jumper On, bottom jumper Off = Channel 5.
Top jumper Off, bottom jumper Off = Channel 7.



MIDI Notes, Pitch Voltages, Oscillators, MIDI Controllers

Pitch voltages are scaled to the industry standard of 1-volt-per-octave with a typical useful range of 0v to 10v (10 Octaves).

Q174 MIDI Interface
The Q174 MIDI Interface module produces a specific Pitch output voltage for each of the 128 possible incoming MIDI note messages. These Pitch voltages range from 0V to 10V. A default transposition of -36 notes (3 octaves) within the Q174 allows many keyboards to produce 0v at their lowest C key (MIDI note #36). A circuit board jumper selects transposition of 0 causing MIDI note #0 to produce 0 volts and MIDI note #120 to produce 10 volts. This operation might be preferable when the Q174 is driven by a computer.

Q106 Oscillator
The Q106 Oscillator responds to 1-volt-per-octave scaling by doubling the output frequency for each volt. The frequency that the oscillator produces is a function of the Range switch, the Frequency knob, and each input voltage. All of these controls along with the various input voltages are added together inside the oscillator to produce a specific frequency. With the Range switch set to 32', the Frequency knob set to approximately zero, and no voltages applied, the Q106 produces a frequency of 31.7hz (C2*).

MIDI Keyboard Controllers
A typical MIDI keyboard controller will produce MIDI note #36 (C2*) for the lowest C key when the transpose setting is set to zero. This varies among manufacturers and models. Some keyboard controllers will allow transposing the keyboard throughout the useful range, but if not, the oscillators can be transposed using their Range switches, or by using a utility module such as the Q123 Standards module.

Notes and Pitch Voltages
The absolute voltage-to-frequency relationship is of minor importance since oscillator Range switches provide transposing as do other modules such as the Q123 Standards module. What matters is that the relationship between notes remains accurate and repeatable.

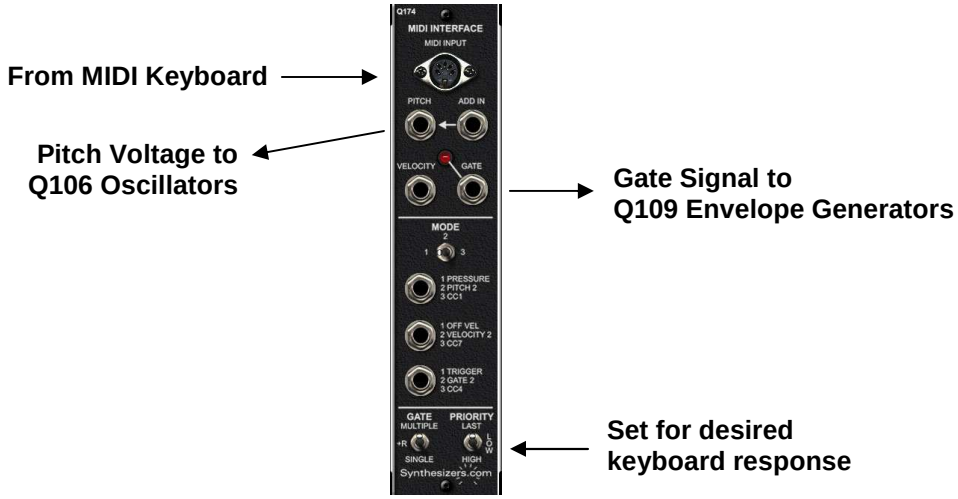
This chart shows how the incoming MIDI notes map to Pitch output voltages. They wrap around to create a continuous series of voltages for incoming MIDI note messages to make best use of typical MIDI controller outputs and usable voltages to drive oscillators.

MIDI Note Number	Note Name*	Pitch Voltage	
0	C-1	7V	
12	C0	8V	
24	C1	9V	
36	C2	0V	(Typically first C on a keyboard controller)
48	C3	1V	
60	C4	2V	(Middle C)
72	C5	3V	
84	C6	4V	
96	C7	5V	
108	C8	6V	
120	C9	7V	

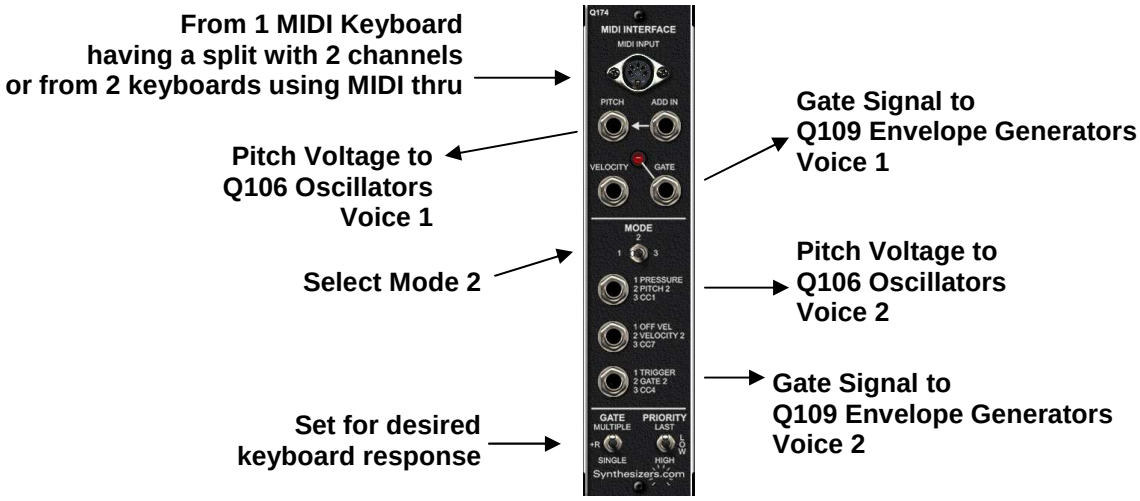
* MIDI Note Names are not standardized

Patching Notes

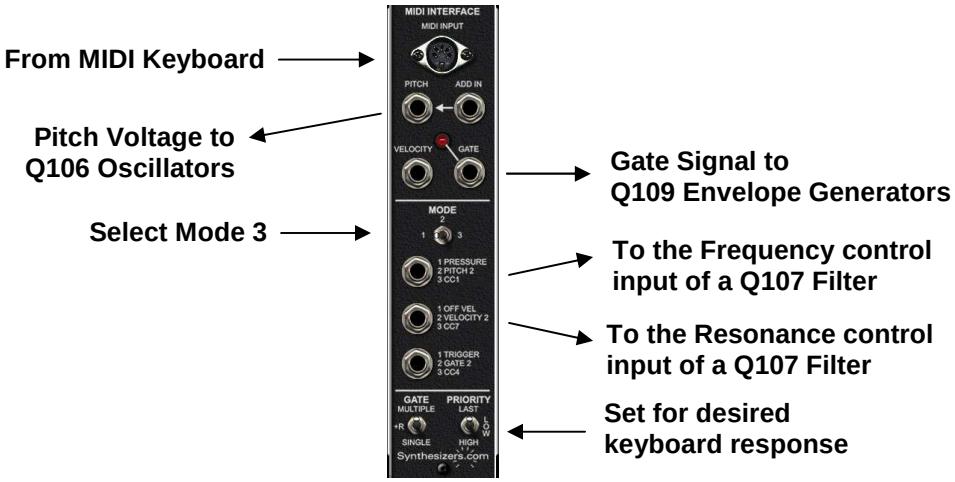
This basic patch uses the Q174 as a single-channel MIDI interface to the synthesizer.



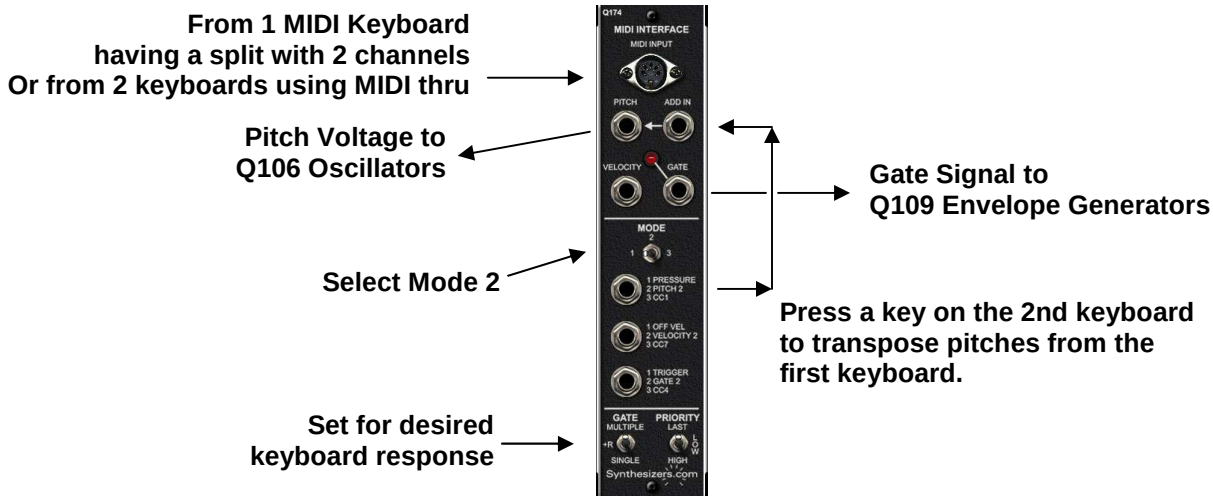
Mode 2 operation allows the Q174 to be used as a dual-channel MIDI interface for synthesizer 2 voices.



Using Mode 3, the Q174 can produce signals from knobs of a MIDI keyboard to control filter parameters via Continuous Controller Messages.



Use the Add-In jack to transpose the first keyboard from a second keyboard.



Calibration

Adjust the trim-pot to exactly 5.000 volts using a precision voltmeter attached to the +5 REF jack.

Voltage variances - Analog inputs and outputs will typically be within 2-10mv of their ideal. Typically these variations are in the form of an offset that remains fairly steady throughout the 10 volt range and are undetectable under most circumstances.

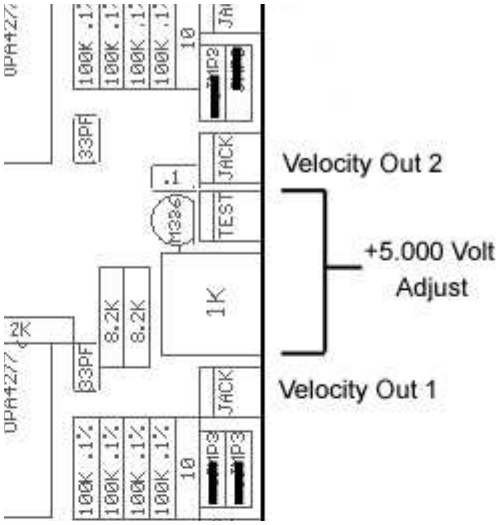
Power Connector

6 pin .1" MTA type connector made by AMP. Available from Mouser Electronics or Digi-Key. Modules have a male PCB mount connector and cable harnesses have a female.

Part Numbers:
Female cable mount: #6404416
Male PCB mount: #6404566

Pinout:
1 = +15v
2 = key (pin removed)
3 = +5v
4 = gnd
5 = -15v

Reference Voltage Adjustment Location



Circuit Board Connector Layout

The following drawing shows all of the connections for the Q174 front panel along with jumper settings and the voltage adjustment.