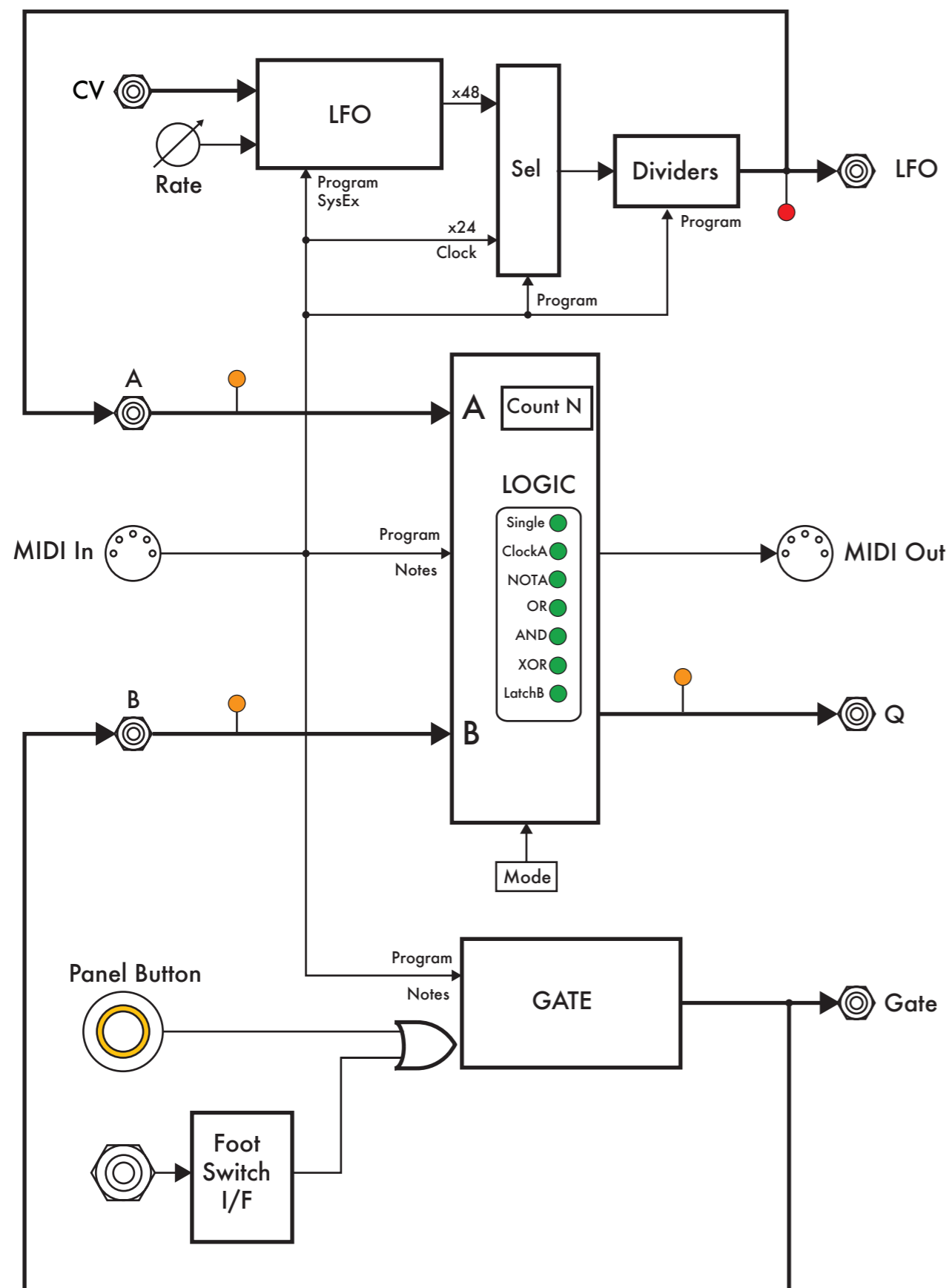## GateLogic Signal Flow



## MIDI Control

All settings within GateLogic may be set using MIDI Program Changes. The logic mode and the N count number may also be set from the front panel, but the remainder of the more advanced options may only be set through MIDI. A DAW, MIDI utility program or good MIDI Controller is needed for this purpose. Unfortunately a lot of MIDI Controllers now send Program Changes by Inc/Dec buttons which means that there is no random access and every setting between two numbers will be altered, so avoid this type. A bank of eight buttons is perfect and all the settings are organised for this style. We also have the PatchMaster module which can send all 128 Program Changes as two banks of 64 as well as other special messages.

If using more than one GateLogic they may be set to different MIDI Channels individually by using PatchMaster or a SysEx utility. They may then be addressed by a single controller by changing its Channels.

GateLogic may derive a monophonic MIDI Gate (any note held) from incoming MIDI as an alternative source of the internal Gate. This feature is turned on by MIDI Program Change #72 and off by #73.

The LFO knob may be used as a General Purpose Continuous Controller #1 when in normal use as the LFO Rate control, i.e. not in N setting mode. This feature is turned on by MIDI Program Change #74 and off by #75.

MIDI Clocks may be used instead of the LFO by MIDI Program Change #72 enabling all clocked modes to be synchronised with a MIDI tempo. MIDI Clocks are disabled by selecting one of the four LFO ranges with Program Change #65-68.

The LFO is considered a x48 clock whereas MIDI Clocks are x24 the beat rate. The selected clock is then pre-scaled by either ÷6 to sixteenth notes, ÷4 to eighth triplets or ÷1 and then divided by 1 to 8 set by MIDI Program Change #57-64. e.g. for a quarter note rate the prescaler should be ÷6 and the divider ÷4. The final LFO output is divided by 2 to generate a squarewave. When the LFO is the source the period will be the BPM rate with divisions, when MIDI is the source the high half cycle period will be that duration.

A 2:12 MIDI Thru pcb is available for internal MIDI distribution. This may be built as a module with front panel DIN sockets or as an internal card.
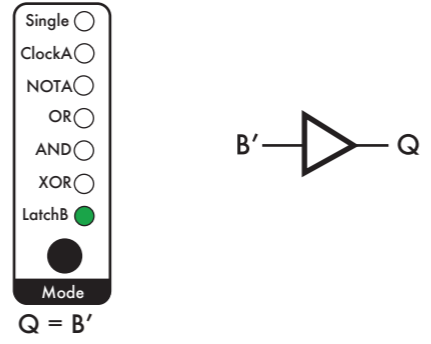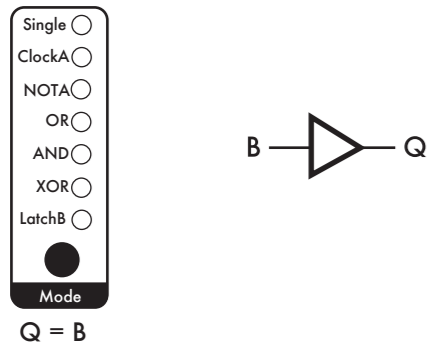
# GateLogic

## Modes

GateLogic has 38 modes of operation displayed by the green LEDs and may be advanced with the Mode button.

Each Mode may also be selected by a MIDI Program Change #1 to #38. The first seven modes cover the basic two input gate functions where input A may also be inverted. Although A is normalled from the LFO and B is normalled from the Gate most modes do not have to be this way around and any signal may be used as a logic input and >1.6V is treated as a positive logic true. (Gates also have a negative logic equivalent function given by De Morgan's theorum where <1.6V asserts true.)

The second seven modes repeat this sequence, but input B is latched and cleared on alternative rising edges. This is shown as B'.
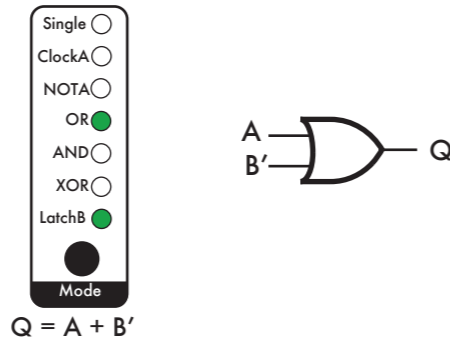
### Mode 1: B is passed through and A has no effect .

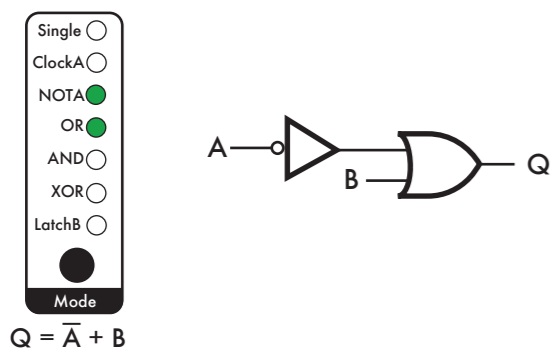Q = B

### Mode 8: B' is passed through. B ÷ 2.

Q = B'

### Mode 2: OR function, either input .

Q = A + B
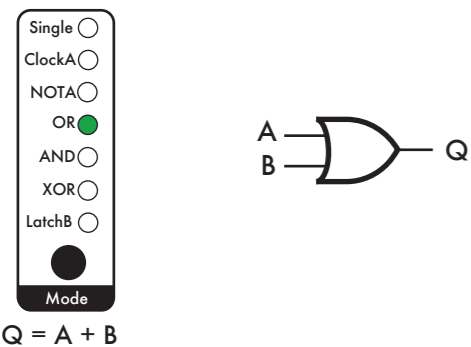
### Mode 9: A OR-ed with latched B

Q = A + B'

### Mode 3: OR function with inverted A.

Q = $\overline{A}$ + B

### Mode 10: Not A OR-ed with Latched B

Q = $\overline{A}$ + B'
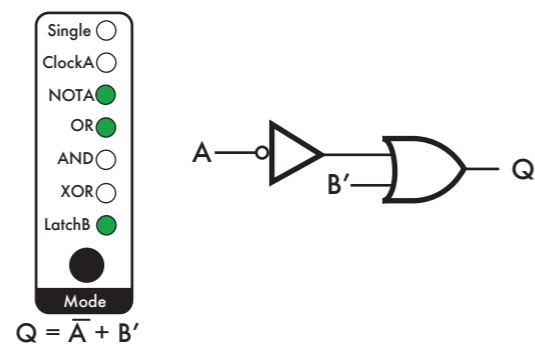
# GateLogic

### Mode 4: AND function, both inputs.

Q = A . B
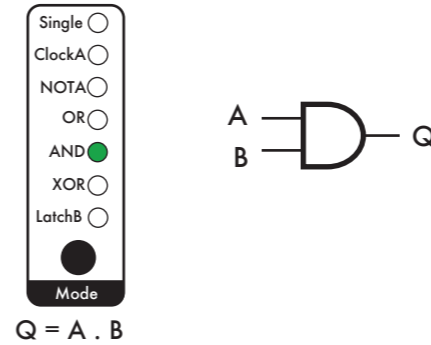
### Mode 11: A AND Latched B

Q = A . B'
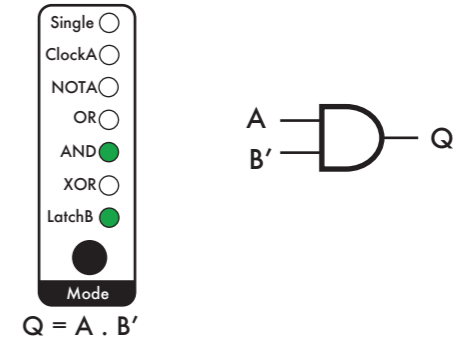
### Mode 5: AND function with inverted A .

Q = $\overline{A}$ . B
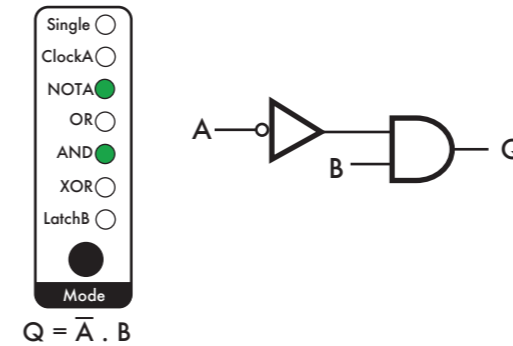
### Mode 12: Not A AND Latched B

Q = $\overline{A}$ . B'
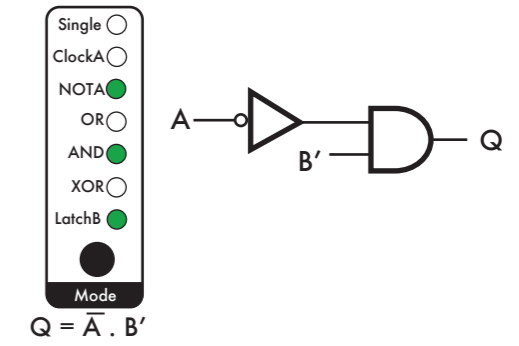
### Mode 6: XOR function, either input, but not both.

Q = A ⊕ B
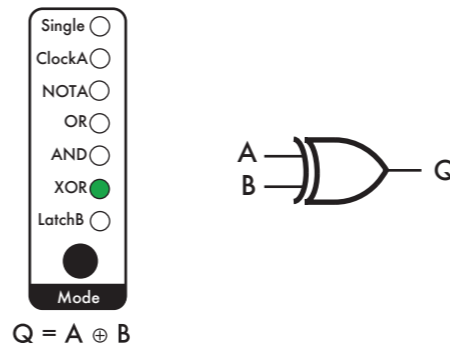
### Mode 13: A XOR Latched B

Q = A ⊕ B'
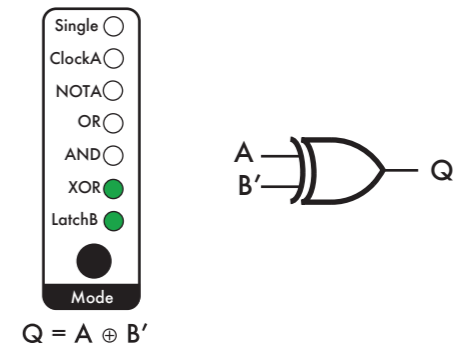
### Mode 7: XOR function with inverted A .

Q = $\overline{A}$ ⊕ B
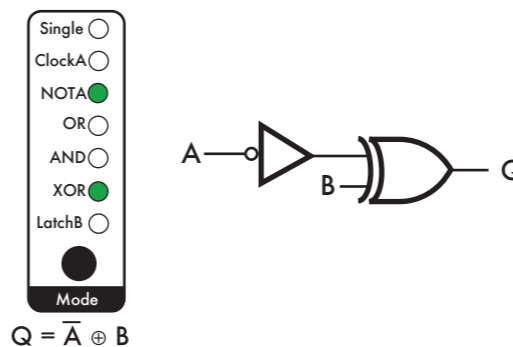
### Mode 14: Not A XOR Latched B

Q = $\overline{A}$ ⊕ B'
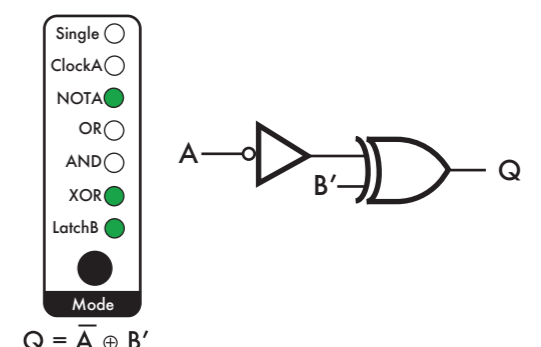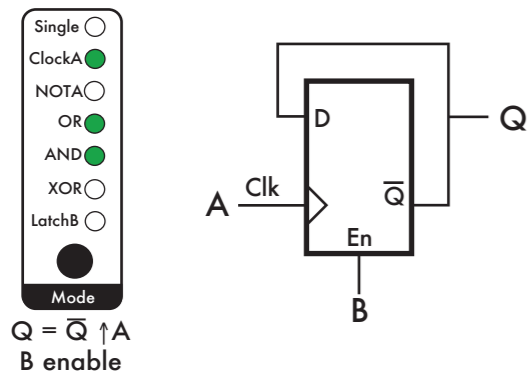
XOR modes may be used with audio frequencies as a digital ring modulator".
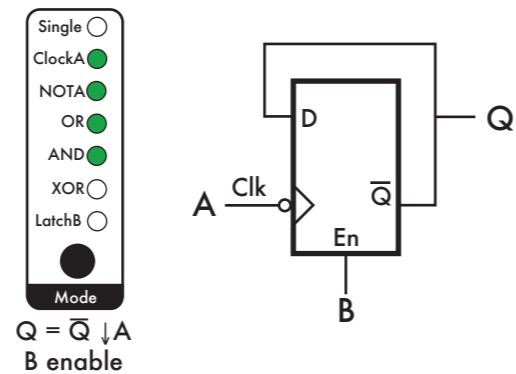
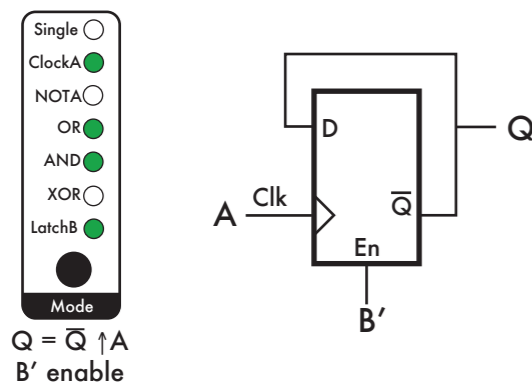Eight modes implement logic Flip-Flop functions for D-type and S-R latches :
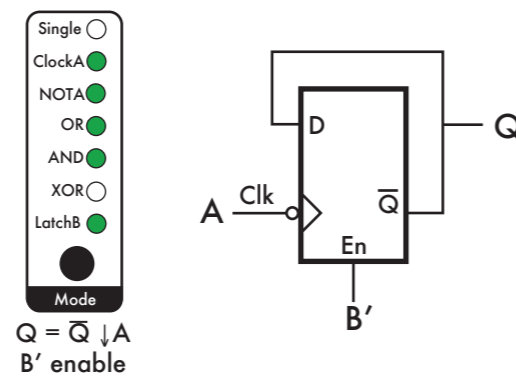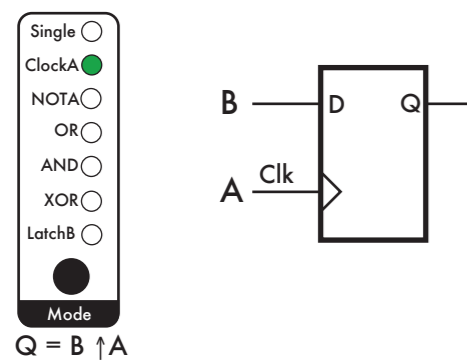
## Mode 15: Toggle on rising A while B.



$Q = \overline{Q} \uparrow A$
B enable

## Mode 16: Toggle on falling A, while B.



$Q = \overline{Q} \downarrow A$
B enable

## Mode 17: Toggle on rising A, while B latched



$Q = \overline{Q} \uparrow A$
B' enable

## Mode 18: Toggle on falling A, while B latched



$Q = \overline{Q} \downarrow A$
B' enable

## Mode 19: B latched on rising A.



$Q = B \uparrow A$

## Mode 20: B latched on falling A



$Q = B \downarrow A$
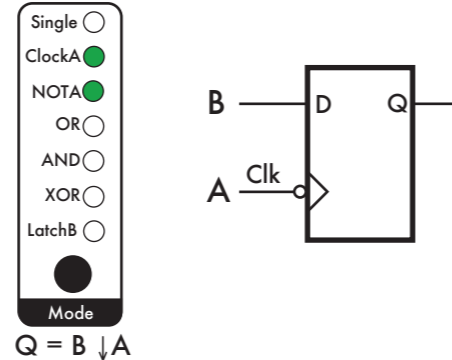
## Mode 21: Set by rising A, Reset by B.



$Q = \uparrow A$ set
B reset
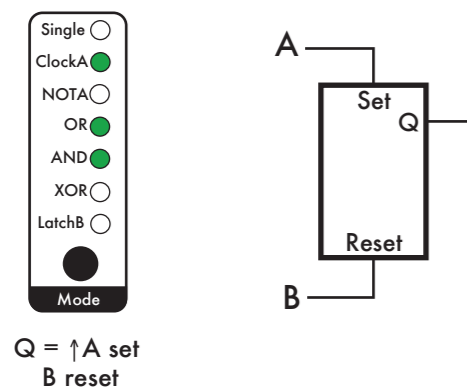
## Mode 22: Set by falling A, reset by B.



$Q = \downarrow A$ set
B reset
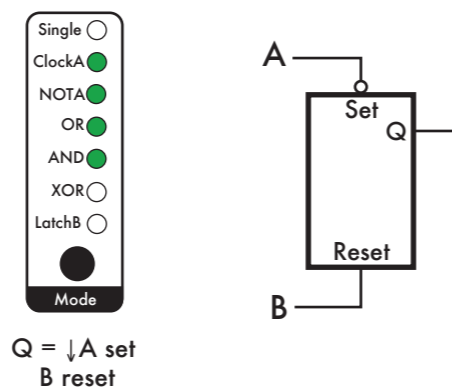
The next four modes use the LFO section differently. Although the LFO is normalled to the A input this will have no effect. Instead an external signal must trigger A and then the LFO output will rise for the LFO period and then fall. The status is internally routed to the logic section.

The prescaler, divider and MIDI Clock select are still operative so the delay period may be in terms of note lengths at an internal or external tempo.
If the Gate output MIDI Gate is enabled and externally patched to A the Q output may be quantised or delayed by MIDI Clock periods.

## Mode 23: Monostable, triggered by A.



$Q = \overline{A \text{ hold}}.A$
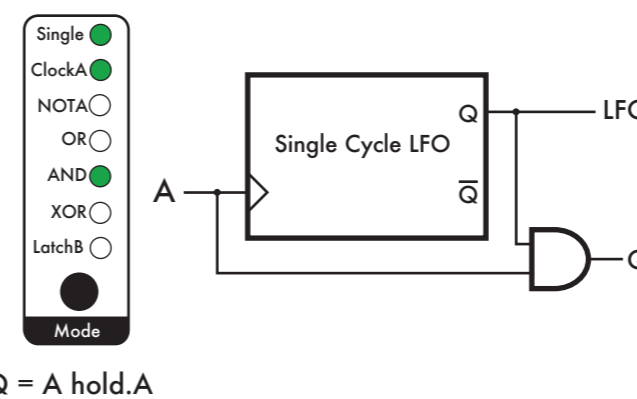
## Mode 24: Delayed A, triggered by A



$Q = \overline{A \text{ hold}}.A$
(delay)
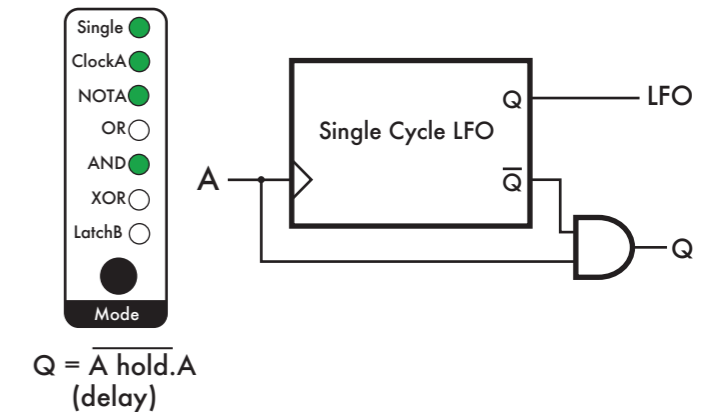
Monostable time varies from 5ms with LFO in Ultra Wide range, Clock Divider ÷1, and Clock Prescale ÷1. The maximum period is with LFO Rate at minimum, Clock Divider ÷8 and Clock Prescale ÷6. MIDI x24 clocks may also be counted.
N.B.These settings have to be made via MIDI Program Changes which may be generated by PatchMaster.

## Mode 25: A or Delayed A selected by B.



$Q = \overline{A \text{ hold}}.A.B$
$+ A.\overline{B}$
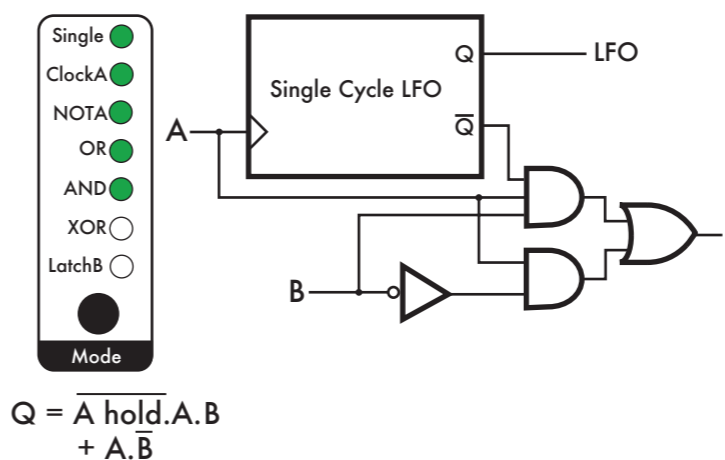
## Mode 26: A or Delayed A selected by latched B



$Q = \overline{A \text{ hold}}.A.B'$
$+ A.\overline{B'}$
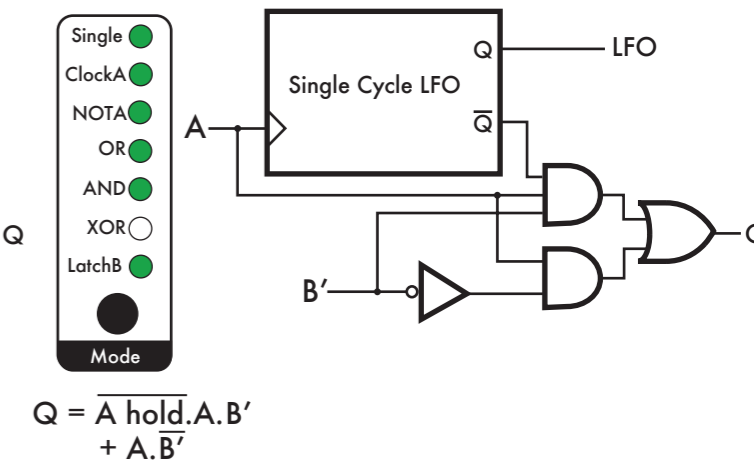
## Mode 27: Divide A clocks by N, while B.



Q = A÷n
B enable

## Mode 28: Divide A clocks by N, while B latched.



Q = A÷n
B' enable
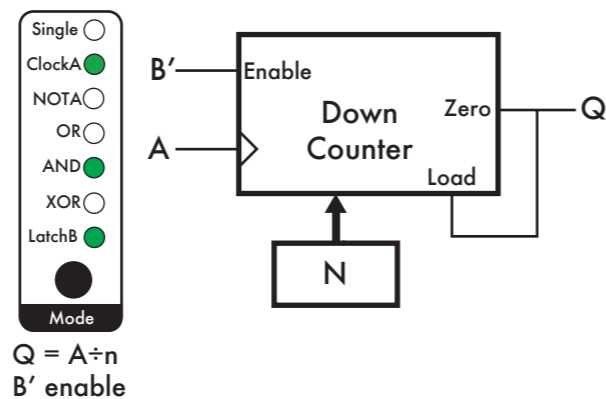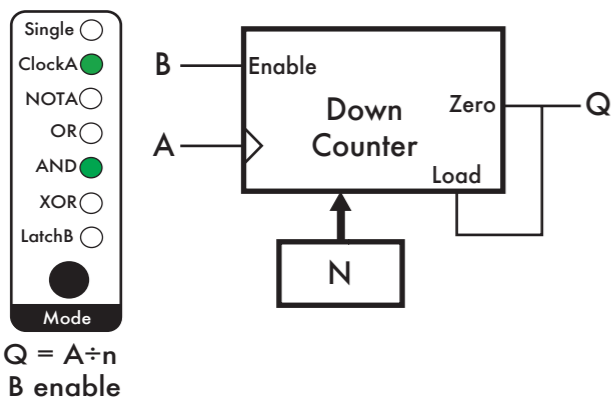
Both divide modes provide division ratios from 1 to 16 according to the value of N. N may be read or set on the front panel by holding the Mode button in or by a MIDI Program # 33 to 48.

## Mode 29: Count N A clocks, while B.



Q = n x A
B enable

## Mode 30: Count N A clocks, until B.



Q = n x A
B reset
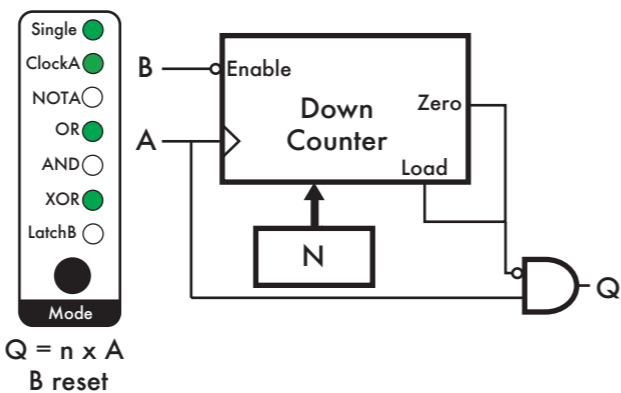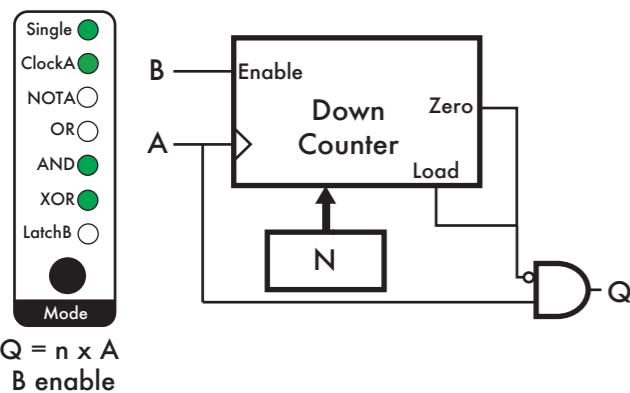
The Q output follows the pulse width of the A input clock until counted out or disabled.

These two modes convert the Q output to Hinton Instruments' combined Gate & Trigger standard for use with retriggerable envelopes using a single cable.
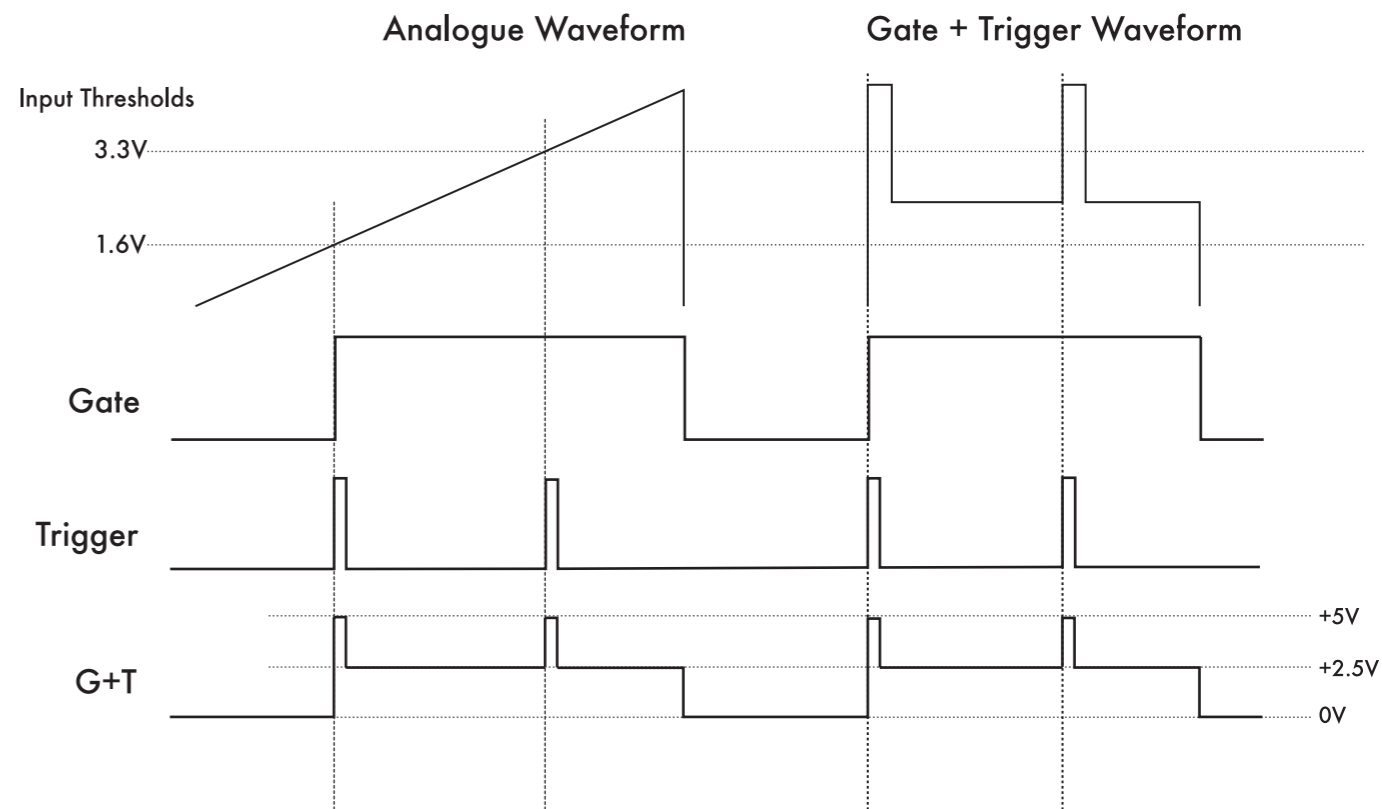


## Mode 31: Count N triggers combined with Gate B.



Q = n x A
B Gate

Similar to Mode 29 except the B Gate enable is also output. May be used for repeat triggered AD parts of an ADSR envelope.

## Mode 32: Combine Trigger A with Gate B.



Q = A U B

Q is the simple combination of A and B preserving the timing of both without alteration.

# GateLogic

**Modes 33 & 36:** Rising edge of B.

Program 33  5:1 — Single ○, ClockA ●, NOTA ○, OR ○, AND ○, XOR ●, LatchB ○, Mode ●

Program 36  5:4 — Single ○, ClockA ●, NOTA ○, OR ○, AND ○, XOR ●, LatchB ●, Mode ●

$Q = \uparrow B \uparrow A$
A width

$Q = \uparrow B' \uparrow A$
A width
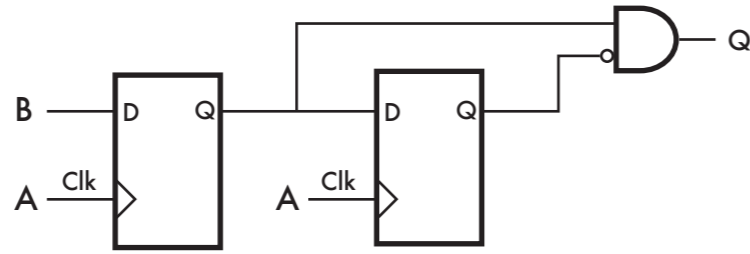
**Modes 34 & 37:** Falling edge of B.

Program 34  5:2 — Single ○, ClockA ●, NOTA ●, OR ○, AND ○, XOR ●, LatchB ○, Mode ●

Program 37  5:5 — Single ○, ClockA ●, NOTA ●, OR ○, AND ○, XOR ●, LatchB ●, Mode ●

$Q = \downarrow B \uparrow A$
A width
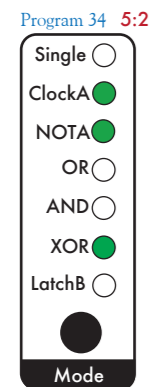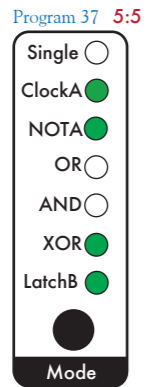
$Q = \downarrow B' \uparrow A$
A width
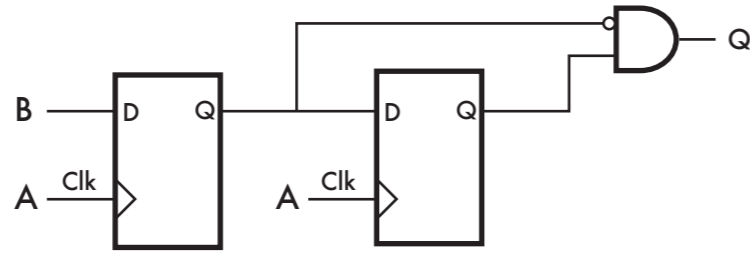
**Modes 35 & 38:** Rising and falling edges of B.

Program 35  5:3 — Single ○, ClockA ●, NOTA ○, OR ●, AND ○, XOR ●, LatchB ○, Mode ●

Program 38  5:6 — Single ○, ClockA ●, NOTA ○, OR ●, AND ○, XOR ●, LatchB ●, Mode ●

$Q = \uparrow\downarrow B \uparrow A$
A width

$Q = \uparrow\downarrow B' \uparrow A$
A width
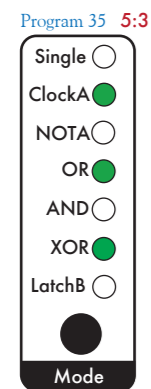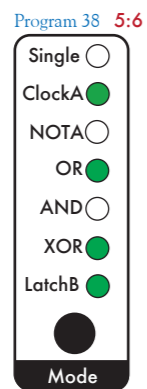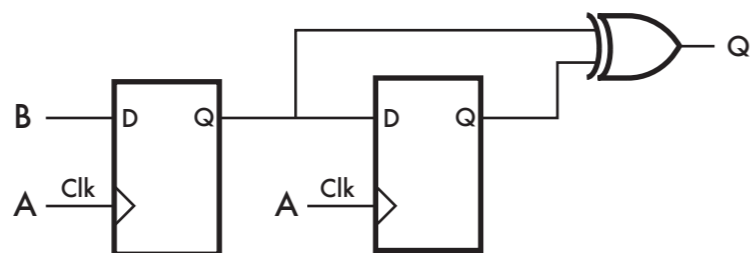
### Count Number (N) Setting

To change the count number (N) hold the Mode button for about 2 seconds. The current number will be displayed on the green LEDs and may be changed with the LFO Rate knob over a range of 1-16. As dividing by 1 is not really a division it is displayed as all LEDs off.
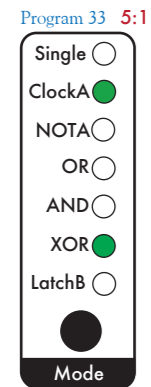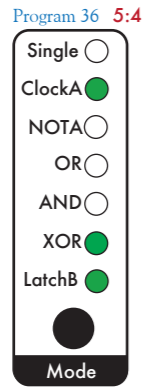
2 to 8 are straightforward with a single LED on, labelled 2-8. The higher numbers 9 to 16 are displayed as a combination of LEDs that add to that number.

The count number may also be set by MIDI Program Changes 41-56.

The full range of codes is shown below:

$\div 1 \qquad \div 2 \qquad \div 3 \qquad \div 4 \qquad \div 5 \qquad \div 6 \qquad \div 7 \qquad \div 8$

$\div 9 \qquad \div 10 \qquad \div 11 \qquad \div 12 \qquad \div 13 \qquad \div 14 \qquad \div 15 \qquad \div 16$
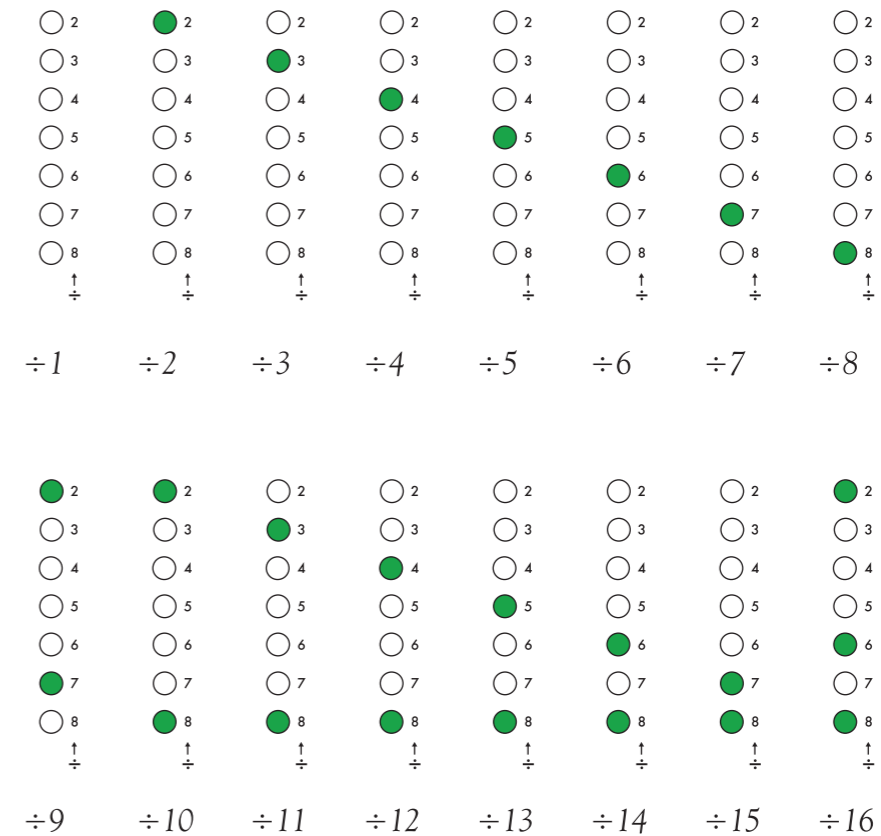
On releasing the mode button the LFO knob may not match the LFO rate and will operate in an "Elastic" relative mode until it matches again. The LFO rate will not jump and the full range is still adjustable.

## HINTON INSTRUMENTS

## System Exclusive

The MIDI Channel is set from a System Exclusive message (PatchMaster can generate these):

`<F0h, 2Dh, '!', 0000cccc, F7h>`

cccc = MIDI Channel Number in binary 0-15.

A set of SysEx files for all 16 Channels is available on the GateLogic web page.

The LFO may be directly controlled by loading its 24 bit increment value:

`<F0h, 2Dh, 'L', 47h, 00aaaaaa, 00bbbbbb, 00cccccc, 00dddddd, F7h>`

where abcd = 24 bit increment as four 6-bit words

The formula for calculating the increment value is:

$$\text{Integer}( 2^{24} \times \text{Frequency} \div 2000 )$$

e.g. for 38Hz using the OS X Calculator in Programmer mode:
16777216 x 38 / 2000 = 318767 or 0000 0100 1101 1101 0010 1111 in 24 bit binary.

rearrange the binary as six bit groups, a = 000001, b = 001101, c = 110100, d = 101111.

making the SysEx message: `<F0h, 2Dh, 4Ch, 01h, 0Dh, 34h, 2Fh, F7h>`

The LFO may be restored by sending MIDI Program Changes 57 - 60.

Numbers and Excel spreadsheets are available on the GateLogic web page to make this easier. Simply type in the frequency to any number of decimal places and copy and paste the resulting highlighted SysEx message into a Hex Editor and save as a ".syx" file, then send the file using a SysEx utility.
Hex Fiend and SysEx Librarian are recommended for MacOS.

## The LFO

Program #65: 8mHz - 100Hz (0.02 - 250bpm)
Program #66: 30Hz - 60Hz    75 - 150bpm
Program #67: 60Hz - 120Hz   150 - 300bpm
Program #68: 38Hz - 54Hz    95 - 135bpm
Program #72: MIDI Clock

÷6 = Sixteenths    ÷4 = Quarter Notes
÷4 = Eighth Triplets
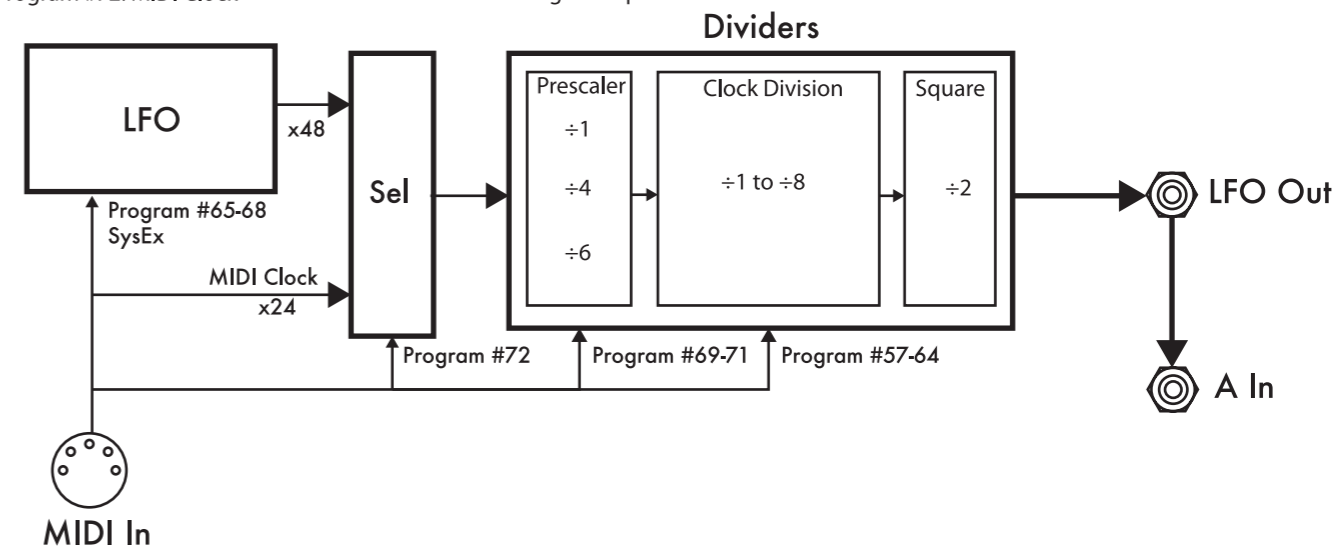


The Low Frequency Oscillator is a precision numeric controlled oscillator capable of generating low frequencies with high accuracy over long time periods, e.g. the length of a song. It is clocked at 2kHz so will jitter at frequencies aproaching that.

Several rate ranges are available optimised for tempo use. The LFO may also be loaded with a rate via a MIDI SysEx message in which case it will ignore the knob and CV values until another rate range is selected by MIDI Program #65-68.

The Divide chain ends with a ÷2 stage to give a 50% duty cycle squarewave output at the set rate. When used in Delay modes the delay time is the positive half of the period. When MIDI Clock is selected the positive duration is the note time and the LFO output is half the tempo rate. Dividers should be adjusted accordingly.

HINTON INSTRUMENTS

HINTON INSTRUMENTS

# GateLogic

MIDI Program Changes 1 to 64

| | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 | Group 8 |
|---|---|---|---|---|---|---|---|---|
| | 1-8 Modes | 9-16 Modes | 17-24 Modes | 25-32 Modes | 33-40 Modes | 41-48 Count N | 49-56 Count N | 57-64 Clock Division |
| 1 | Q=B | OR Q=A+B' | Toggle Q=/Q ↑A B' enable | Delay Q= /Ahold.A.B + A./B | Q = ↑B ↑A A width | ÷1 | ÷9 | ÷1 ♪ Sixteenth |
| 2 | OR Q=A+B | IOR Q=/A+B' | Toggle Q=/Q ↓A B' enable | Delay Q= /Ahold.A.B' + A./B' | Q = ↓B ↑A A width | ÷2 | ÷10 | ÷2 ♪ Eighth |
| 3 | IOR Q=/A+B | AND Q=A.B' | D Latch Q=B ↑A | Divide Q=A÷N B enable | Q = ↑↓B ↑A A width | ÷3 | ÷11 | ÷3 ♪. Dotted Eighth |
| 4 | AND Q=A.B | IAND Q=/A.B' | D Latch Q=B ↓A | Divide Q=A÷N B' enable | Q = ↑B' ↑A A width | ÷4 | ÷12 | ÷4 ♩ Quarter |
| 5 | IAND Q=/A.B | XOR Q=A⊕B' | SR Latch Q=set ↑A B reset | Dead Counter Q= NxA B enable | Q = ↓B' ↑A A width | ÷5 | ÷13 | ÷5 ♩+♪ Five Sixteenth |
| 6 | XOR Q=A⊕B | IXOR Q=/A⊕B' | SR Latch Q=set ↓A B reset | Dead Counter Q= NxA B' enable | Q = ↑↓B' ↑A A width | ÷6 | ÷14 | ÷6 ♩. Dotted Quarter |
| 7 | IXOR Q=/A⊕B | Toggle Q=/Q ↑A B enable | Monostable Q=Ahold.A | Retrigger Q=NxA B enable | | ÷7 | ÷15 | ÷7 ♩.. Double Dotted Quarter |
| 8 | Q=B' | Toggle Q=/Q ↓A B enable | Delay Q=/Ahold.A | Gate & Trigger | | ÷8 | ÷16 | ÷8 ♩ Half |

# GateLogic

MIDI Program Changes 65 to 64

| | Group 9 | Group 10 |
|---|---|---|
| | 65-72 LFO Range | 73-76 Gate |
| 1 | LFO Ultra Wide Range 8mHz -100Hz | MIDI Gate Disable |
| 2 | LFO Low Range 75-150bpm | MIDI Gate Enable |
| 3 | LFO High Range 150-300bpm | Knob CC Disable |
| 4 | LFO Fine Range 95-135bpm | Knob CC Enable |
| 5 | Prescale Sixteenths (÷6) | |
| 6 | Prescale Eighth Triplets (÷4) | |
| 7 | x24 Clock (÷1) | |
| 8 | MIDI Clock Select | |

Once changed the default values are lost and may only be restored via MIDI.

HINTON INSTRUMENTS

Version 1.1
March 2024

# GateLogic

## MIDI Implementation Chart

| Function | | Transmitted | Recognised | Remarks |
|---|---|---|---|---|
| **Basic Channel** | Default<br>Changed | 1-16 | 1-16 | |
| **Mode** | Default<br>Messages<br>Altered | X | O | * Note 4 |
| **Note Number** | True Voice | O | O | |
| **Velocity** | Note On<br>Note Off | O<br>X | O<br>O | Last note received is<br>transmitted on Q |
| **Aftertouch** | Key<br>Channel | X<br>X | X<br>X | |
| **Pitch Bend** | | X | X | |
| **Control Change** | | O | X | * Note 5 |
| **Program Change** | | X | O | * Note 2 |
| **System Exclusive** | | X | O | * Note 3 |
| **System Common** | MTC<br>Song Position<br>Song Select<br>Tune | X<br>X<br>X<br>X | X<br>X<br>X<br>X | |
| **System Real Time** | Clock<br>Commands | O<br>O | O<br>O | * Note 1<br>* Note 1 |
| **Aux Messages** | Local ON/OFF<br>All Notes Off<br>Active Sense<br>Reset | X<br>X<br>X<br>X | X<br>O<br>X<br>X | |

Notes: 1. Every MIDI Real Time message is passed thru.

2. Program 1-38 set the Mode, 41-72 set LFO and divisions,
72 and 73 toggle MIDI Gate enable.
74 and 75 toggle MIDI CC enable.

3. MIDI Channel and LFO Inc are set by SysEx

4. ANO and Channel Mode changes clear all notes.

5. Knob value may be sent as CC GP#1

O : Yes
X : No

## HINTON
### INSTRUMENTS

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