TapTation

General Datasheet and Application Note

Rev. v1.0

Description:

TapTation is a tap tempo controller which produces various time related outputs based on input data from various sources.

Input sources can be a DC voltage like that of a potentiometer, external logic clock, or a switch.

Output types include logic clock pulses or a PWM generated triangle waveform. The controller can also adjust the delay time of PT2399 based delays via a MCP41100 compatible digital potentiometer.

The controller can scale the tempo output through various input pin configurations.

Features:

- Self contained controller
- System Tempo can be set from 25ms to 1125ms with an average accuracy of 5ms
- Variable voltage time control
- Logic clock input
- Accepts either Toggle or Momentary tempo input switches
- Quarter / Eighth / Dotted Eighth selectable tempo scaling with double tempo mode for Eighth / Sixteenth / Dotted Sixteenth tempo scaling
- PT2399 delay control via MCP41100 compatible digital potentiometer
- Clock pulse output for base tempo and scaled tempo
- PWM based triangle output with selectable full and half period cycle modes
- Very few external parts needed
- Small 14 pin DIP package
- Single supply operation (2.7V - 5V)
- Low power consumption

Applications:

- Low Frequency Oscillator (LFO) (i.e. for effects such as tremolo and phaser)
- Clock source for logic based circuits (i.e. sequencers)
- PT2399 based delay control

Pin Configuration:

Pin Number	Function
1	Vcc
2	Tempo Clock Input
3	Tempo Clock Output
4	Tempo Clock Pulse Mode Input
5	Tempo Scale Output
6	Tempo PWM Output
7	Tempo PWM Cycle Speed Input
8	Digital Potentiometer Select Output
9	Digital Potentiometer Clock Output
10	Digital Potentiometer MOSI Output
11	Tempo Double Time Input
12	Tempo Scale Input
13	Tempo Voltage Input
14	GND

Electrical Characteristics:

Absolute Maximum Ratings

Operating Temperature	**-55C to +125C**
Storage Temperature	**-65C to +160C**
Voltage on pins with respect to ground	**-1.0v to Vcc+0.5V**
Operating Voltage	**6.0V**
DC Current per I/O pin	**40.0mA**
DC Current Vcc and GND pins	**200.0mA**

DC Characteristics

Parameter	Condition	Min	Max	Unit
Power Supply Voltage	-	2.4	5.5V	V
Input Low Voltage	Vcc = 2.4V – 5.5V	-0.5	0.3Vcc	V
Input High Voltage	Vcc = 2.4V – 5.5V	0.6Vcc	Vcc +0.5	V
Output Low Voltage	Vcc = 5V 10mA	-	0.6	V
Output High Voltage	Vcc = 5V -10mA	4.3	-	V
Power Supply Current	Vcc = 5V	1.1	1.35	mA

Specifications:

Parameter	Condition	Min.	Max.	Unit
Tempo Voltage Input	Vcc = 5V	0	5	V
System Tempo	Vcc = 5V 3 to 5 ms Accuracy	25	1125	ms
Tempo Clock / Scale Output Pulse	Vcc = 5V	50	55	ms
Tempo PWM Output	Vcc = 5V	0.2	4.8	V
Tempo PWM Frequency	Vcc = 5V	308	312	KHz

Power Supply

A clean stable power supply delivering between 2.4V and 5.5V is required for operation. In addition to power supply filtering a 0.1uF capacitor should be mounted as close as possible to the TapTation's Vcc / GND pins. A ceramic capacitor is sufficient for this function.

If the controller is going to be used with a PT2399 based circuit then it is likely the same power supply for the PT2399 can also be used to power the TapTation controller but attention should paid to make sure the power supply can handle the extra current loads of the TapTation controller, digital potentiometer, and any other loads like LEDs.

Inputs

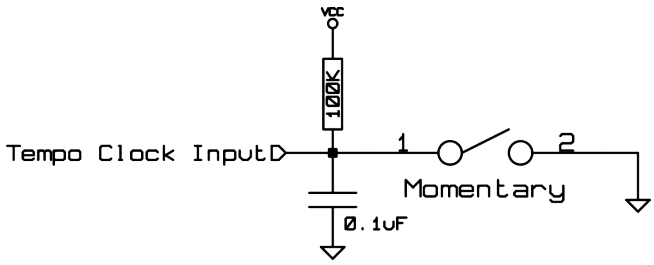
Tempo Clock Input

When two or more logic clock pulses are received on the **Tempo Clock Input** pin the system tempo will be set to match the time between pulse cycles. This new tempo will override the current system tempo setting including the tempo set by the **Tempo Voltage Input**.

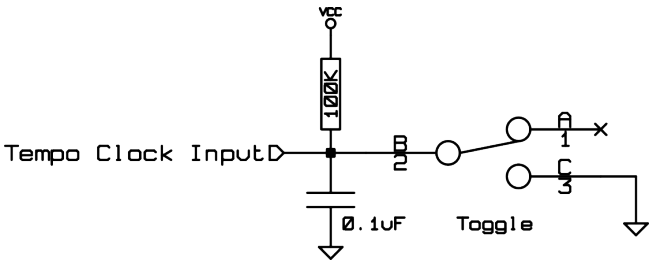
A minimum of two clock pulses are required set the system tempo. When more then two clock pulses are received the tempo will be set to the average time between the pulses up to the last four pulses. If only one pulse is received the system tempo will remain unchanged. The tempo will be set after the time from the last pulse exceeds the maximum tempo time.

The input pulse will be sensed either on the falling edge of the pulse or on both the rising and falling edges of the pulse depending on how **Tempo Clock Pulse Mode Input** is set.

The input clock source can either be a logic signal or a switch with a pull up resistor and an appropriate capacitor for de-bouncing.



Momentary Switch



Toggle Switch

When operating from a tempo set by the **Tempo Clock Input** the **Tempo Voltage Input** will be ignored until the DC voltage is changed by more then 5.0% from the previous reading before the **Tempo Clock Input** took over.

Tempo Clock Pulse Mode Input

The behaviour of the **Tempo Clock Input** is controlled by the **Tempo Clock Pulse Mode Input** pin. Leaving this input unconnected will cause the **Tempo Clock Input** to only sense the falling edge of the pulse. Connecting this pin to ground (GND) will cause the **Tempo Clock Input** pin to read both the falling and rising edges of the clock pulse.

The pin can be adjusted at any time during normal operation.

With logic clock sources reading only the falling edge should be used with clock sources that do not have a 50% duty cycle otherwise both signal edges will be sampled causing an inaccurate reading. If the clock source has 50% duty cycle and changes it's state on each clock cycle then sense the falling and rising edges.

When using a switch with the **Tempo Clock Input** pin leave the **Tempo Clock Pulse Mode Input** pin unconnected for a momentary switch. For a toggle switch connect the **Tempo Clock Pulse Mode Input** pin to ground (GND).

Tempo Clock Pulse Mode Input	Tempo Clock Input Sampling	Logic Clock Pulse	Switch Type
Unconnected	Falling Edge Only	Not 50% Duty Cycle	Momentary
Ground (GND)	Falling and Rising Edge	50% Duty Cycle	Toggle

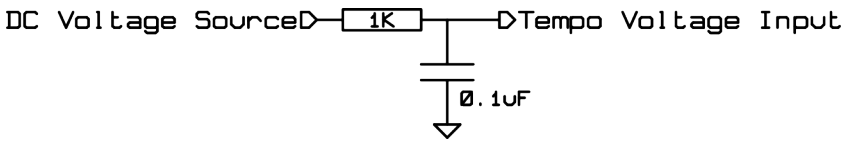
Tempo Voltage Input

The system tempo can be set via a DC voltage source through the **Tempo Voltage Input** pin. This is the default mode when the controller is first powered on. The voltage range on this input should be between ground (GND) and Vcc. The tempo is fastest at ground (GND) and the slowest at Vcc.

When using the **Tempo Voltage Input** the readings will be taken continuously thus the control will always be active when in this mode. Typically the input voltage is adjusted via potentiometer but any DC voltage source that operates within the controller's power supply range will work. A RC network should placed on the input to filter noise that could cause spurious readings.

The **Tempo Voltage Input** will be ignored if the system tempo has been set via the **Tempo Clock Input**. The **Tempo Voltage Input** will continue to be ignored until the voltage varies by more then 5.0% from the last reading before the system tempo was set through the **Tempo Clock Input**. When this happens the control of the system tempo will transfer back to the **Tempo Voltage Input** overriding tempo set by the **Tempo Clock Input**.

If the **Tempo Voltage Input** is going to be unused then connect the pin to a known DC voltage level for example ground(GND). If the **Tempo Voltage Input** is left unconnected noise can be detected on the input resulting in random tempo changes.

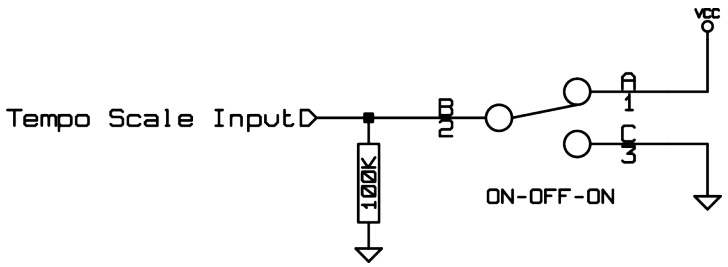


Tempo Voltage Input RC Network

Tempo Scale Input

The output tempo can be scaled for other divisions of the system tempo without having to enter a new tempo.

The **Tempo Scale Input** allows for three different scale settings. To use all three states a ON-OFF-ON SPDT switch with a pull down resistor connected to ground (GND) on the **Tempo Scale Input** pin / centre pole of the switch is needed. The pull down resistor will typically have a value of 100K. When combined with the **Tempo Double Time Input** six different tempo divisions are accessible.



Tempo Switch

Tempo Scale Input	Tempo Double Time Input	Tempo Division	Note Length (Quarter Note as Base)
Pull Down Resistor	Unconnected	3/4	Dotted Eighth
Vcc	Unconnected	1/2	Eighth
Ground (GND)	Unconnected	1/1	Quarter
Pull Down Resistor	Ground(GND)	3/8	Dotted Sixteenth
Vcc	Ground(GND)	1/4	Sixteenth
Ground (GND)	Ground(GND)	1/2	Eighth

If the 3/4 and 3/8 divisions are not needed then the pull down resistor can be omitted and an ON-ON SPDT switch can be used.

The pin can be adjusted at any time during normal operation.

Tempo Double Time Input

The various outputs can be set to double of the scale tempo by setting the **Tempo Double Time Input** pin to ground (GND). Leaving the **Tempo Double Time Input** pin unconnected will set the output tempo to normal scale tempo.

The outputs that are affected by the **Tempo Double Time Input** are the **Tempo Scale Output**, **Tempo PWM Output**, and the **Digital Potentiometer Outputs**.

The **Tempo Clock Output** is not affected by the **Tempo Double Time Input** and will output the system tempo no matter what the setting of the **Tempo Double Time Input** is.

Tempo Double Time Input	Tempo
Unconnected	Scale Tempo
Ground (GND)	Double Scale Tempo

The pin can be adjusted at any time during normal operation.

Tempo PWM Cycle Speed Input

The **Tempo PWM Output** cycle can be set to the scale tempo or half the scale tempo. This allows the setting of the **Tempo PWM Output** cycle to match the needs required when using the **Tempo PWM Output** as a LFO for modulation effects.

When being used to modulate delays this input allows the choice of modulation speed that matches the scale tempo which is useful when creating chorus or vibrato type effects.

Tempo PWM Cycle Speed Input	PWM Cycle Speed
Unconnected	Scale Tempo
Ground (GND)	Half Scale Tempo

The pin can be adjusted at any time during normal operation.

Outputs

Tempo Clock Output

A pulse matching the system tempo will output on this pin. The pin will go high at the start of the pulse. The pulse length of the output is approximately 50ms. The output will go high while pulses are being received on the **Tempo Clock Input**.

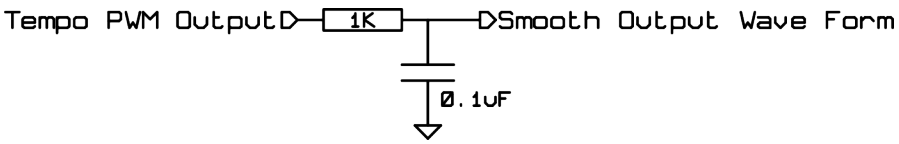
Tempo Scale Output

A pulse matching the scaled tempo will be output on this pin. The **Tempo Scale Input** and **Tempo Double Time Input** control how the system tempo will be scaled. The pin will go high at the start of the pulse. The pulse length of the output is approximately 50ms. The output will go low while pulses are being received on the **Tempo Clock Input**.

Tempo PWM Output

The Pulse Width Modulation (PWM) output on the **Tempo Scale Output** can be used as a LFO for sweep generation or to modulate other parameters like delay time for chorus and vibrato sounds. The rate of the sweep will match the scale tempo either being full or half cycle depending on how the **Tempo PWM Cycle Speed Input** is set.

The output produces a triangle wave form. The high and low peaks of the wave form stay 0.2V from the power supply rails. To achieve a smooth wave form, for example when operating as a LFO, a small RC network is generally required. In other applications where the output is controlling a binary state, for example driving a LED, the network may not be needed.



PWM Smooth RC Network

Digital Potentiometer Outputs

The **Digital Potentiometer Select, Clock,** and **MOSI** outputs are use to interface a MCP41100 compatible digital potentiometer to a PT2399's Frequency Adjustment Pin to adjust the delay time to match the scale tempo.