Bontempo - Datasheet

1 Introduction

Bontempo is a precise Tap Tempo and Modulation integrated solution for PT2399 delay. It is suitable for new designs or modifying well-knowned PT2399 delays.

You can now unlock the full potential of your delay effect units. Explore new sonic territories with fully controllable modulation parameters and 6 modulation waveforms. Get the exact tempo you need with the 6 Tempo divisions.
Keep your settings safe with the two user presets and the save tempo option.

2 Features

- Compensated 8-bit Digital Potentiometer Tap Tempo
- 40ms to 1300ms Delay Time
- 6 Selectable Tempo Divisions
- ±30ms Max. Modulation Depth
- 0.1Hz to 10Hz Modulation Speed
- 6 Selectable Modulation Waveforms
- 2 User Presets
- Clean Mode (limits delay to 600ms for cleaner sound)
- Double Time Mode
- Tempo EEPROM Save
- Dual PT2399 Capability
- Compact DIP-14 Package
- Minimal amount of External Parts

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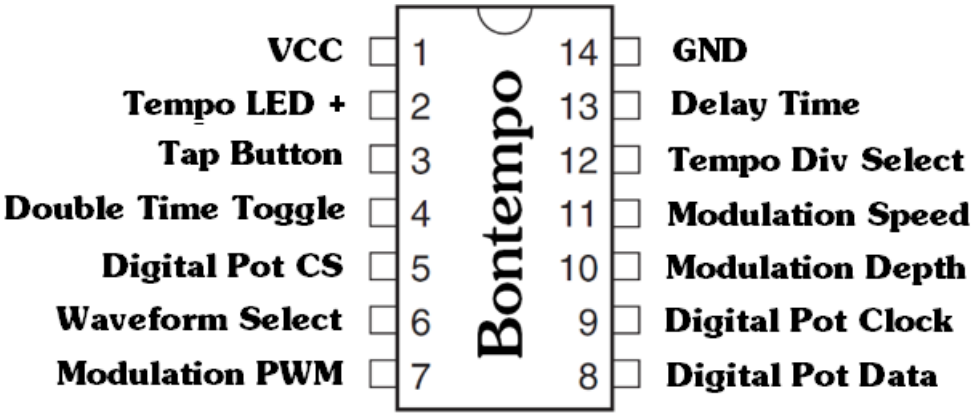
3 Pin Configuration



N°	Name	I/O	Description
1	VCC	I	Supply voltage.
2	Tempo LED +	O	LED indicator output.
3	Tap Button	I	Set tempo when connected to ground.
4	Double Time Toggle	I	Multiply tempo per 2 when connected to ground.
5	Digital Pot Chip Select	O	Part of the SPI interface for the MCP41100 digital potentiometer.
6	Waveform Select	I	The voltage determines the modulation waveform.
7	Modulation PWM	O	PWM output for the MOSFET.
8	Digital Pot Data	O	Part of the SPI interface for the MCP41100 digital potentiometer.
9	Digital Pot Clock	O	Part of the SPI interface for the MCP41100 digital potentiometer.
10	Modulation Depth	I	This pin's voltage determines the modulation depth between 0 and 30ms.
11	Modulation Speed	I	This pin's voltage determines the modulation speed between 0.1 and 10Hz.
12	Tempo Division Select	I	This pin's voltage determines the tempo division selected.
13	Delay Time	I	This pin's voltage determines the delay time between 40 to 1300 ms if no tap sequence is active.
14	GND	I	Ground reference voltage.

Table 1: Pin Configuration

4 Typical Application Schematic

This schematic shows how to implement the Bontempo in a simple delay project. Every options are used.

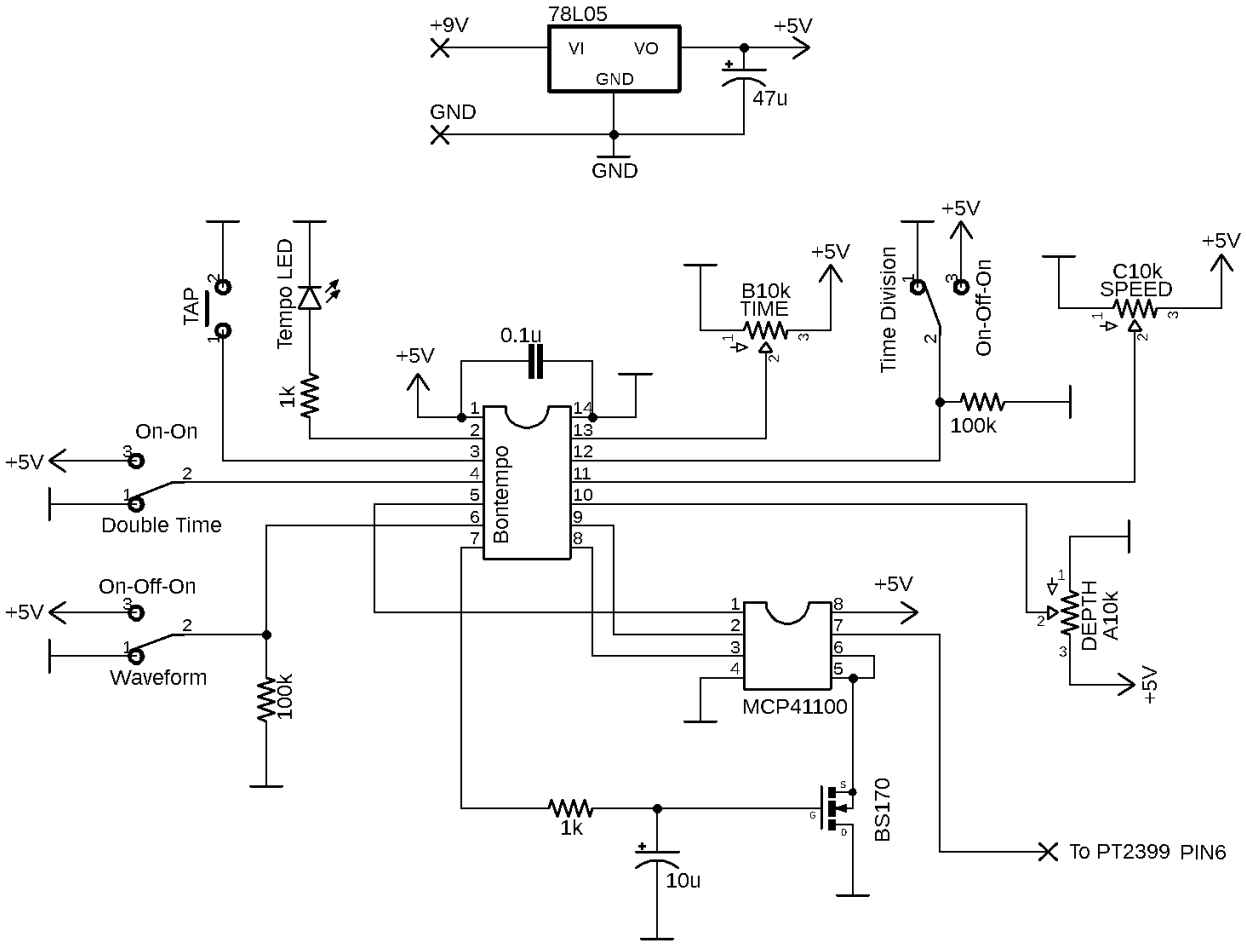


Figure 1: Typical Application Schematic for a single PT2399

5 Absolute Maximum Ratings

Storage Temperature	-65°C to +150°C
Operating Temperature	-55°C to +125°C
Voltage on any pin except pin 4	-0.5V to Vcc + 0.5V
Voltage on Pin 4	-0.5V to +13.0V
Maximum Operating Voltage	+6.0V
DC Current per I/O Pin	40.0mA
DC Current VCC & GND pins	200.0mA

Table 2: Absolute Maximum Ratings

6 DC Characteristics

Parameter	Min	Max	Unit
Power Supply Voltage	2.7	5.5	V
Power Supply Current	4.4	7	mA

Table 3: DC Characteristics

For any other DC characteristics please refer to the ATtiny84A datasheet (p.155).

7 Specifications

Parameter	Min	Max	Unit
Delay Time	37	1306	ms
PWM frequency	-	1	kHz
Modulation Frequency	0.12	10.17	Hz
Modulation Depth	0	30	ms
All Potentiometer/Toggle Input	0	5	V

Table 4: Specifications

All specifications tested at VCC = 5V.

8 Power Supply

The chip will operate with a power supply between 2.7V and 5.5V. However a regulated 5.0V power supply is recommended. This is because the modulated tap tempo was calibrated at 5.0V and a change in Vcc will affect the PWM output voltage. A 0.1μF capacitor should be connected between Vcc and GND and be placed as close to the pins as possible.

If using the same 5V regulator as the PT2399 be careful that the regulator can handle the extra load, and that the Bontempo is fed a correct voltage.

9 Controls

9.1 Tap Tempo Button

This input is only compatible with a momentary switch. The debounce is handled by software so no extra external components have to be used. Debounce time is 500μs.

The program starts counting milliseconds after the first press. The delay time tapped is in effect right after the second press of the tap button. After the second press of the tap button, every following tap in the sequence is averaged in order to reach easily the desired tempo. If the button is not pressed again after a certain time (see below), the timer is reset and the tap sequence is ended. If the tap tempo button is pressed only once, the tap sequence will be aborted after the reset time passed.

Time Division Selected	Normal	Clean Mode
	2.1s	1.4s
	2.5s	1.6s
	3.4s	2s
	4.7s	2.6s
	6s	3.2s
	8.6s	4.4s

Table 5: Tap Sequence Reset Time

The reset time follows this equation: $\frac{MaxDelay}{TempoDivMult} + 800 = ResetTime(ms)$

Max Delay is 1306ms in normal mode and 600ms in clean mode. Tempo Div Mult is the multiplier of the current time division (1,0.75,0.5,0.33,0.25,0.17).

When the tap sequence is active, the tempo LED will blink with the rhythm you tapped, regardless of the selected tempo division.

9.2 Delay Time

This input is to voltage control the delay time. This input will control the delay time until you activate the tap tempo. While the delay time is controlled by this input, the Tempo LED and Scale LED will stay on.

To take back control from the Tap Tempo, you just need to modify this input's voltage by 5%.Typically, you would use a Potentiometer for the delay time control. The recommended potentiometer value is 10kΩ or above, to avoid having too much current going through the pin.

You can add a 0.1μF capacitor between the input and ground for smoother time changes.

9.3 Tempo Division Select

Six different tempo division are accessible with this input. To access every time division a SPDT On-Off-On toggle switch is required.

The first three time divisions are fourth, dotted eighth and eighth. The last three time divisions are accessed by first pressing the tap button and then changing the toggle position while the tap button is pressed. The press will not count as a press for the tap tempo. The three last time divisions are triplet, sixteenth and sextuplet.

The time divisions are selected by changing the Tempo Div Select Pin's voltage (Pin 12).

Pin 12 Voltage	Tempo Division	
	Not Pressed	Button Pressed
GND - 0.39V	Fourth	Triplet
0.4V - 4.4V	Dotted-Eighth	Sixteeth
4.5V - 5V	Eighth	Sextuplet

Table 6: Modulation Waveform Selection

If the time division is changed while the Tap Tempo is active, the delay time will be changed accordingly instantly.

You can access the middle time division by putting a resistor between pin 12 and ground. Any value between 5kΩ and 140kΩ would potentially work, but a 100kΩ resistor is recommended in order not to draw too much current.

9.4 Modulation Depth & Speed

Same recommendations than the Delay Time (10kΩ or more, 0.1μF capacitor ...).

Modulation speed goes from 0.12Hz to 10.17Hz. Modulation depth maximum is 30ms.

9.5 Modulation Waveform Select

Six different modulation waveforms are accessible with this input. To access every waveform a SPDT On-Off-On toggle switch is required. The first three waveforms are sine, square and triangle. The last three waveforms are accessed by first pressing the tap button and then changing the toggle position while the tap button is pressed. The press will not count as a press for the tap tempo. The last three modulation waveforms are Ramp-up, Ramp-Down and random.

The modulation waveforms are selected by changing the Modulation Waveform Select Pin's voltage (Pin6).

Pin 6 Voltage	Waveform	
	Not Pressed	Button Pressed
GND - 0.39V	Sine	Ramp-Up
0.4V - 4.4V	Square	Ramp-Down
4.5V - 5V	Triangle	Random

Table 7: Modulation Waveform Selection

The waveforms can sound a bit asymmetrical at high modulation depth, this is due to the MOSFET's non-linearity.

Like for the Time Division Toggle, a 100kΩ resistor is recommended to access the middle waveform.

9.6 Double Time

The double time divide the time division multiplier per two. This results in tempo that's two time faster. This effect is not affected by preset recall. This effect can be used dynamically or just set as wanted.

When the Double Time Pin (Pin 4) is connected to Vcc, the double time mode is active. If the Double Time Pin is connected to Ground, the double time mode is disabled.

10 User Presets

You can easily save and recall two user presets on the Bontempo. These presets are saved on the Bontempo's EEPROM so that they can survive the power cycles.

To recall preset 1 you must:

- Push the Tap Button and keep it pressed for 3s.
- After the LED blinks once, release the Tap Button.
- The LED will blink once quickly and preset 1 is recalled.

To recall preset 2 you must:

- Push the Tap Button and keep it pressed for 3s.
- Keep it pressed while the LED blinks once.
- After the LED blinks twice, release the Tap Button.
- The LED will blink twice again quickly and preset 2 is recalled.

To save preset 1 you must:

- Push the Tap Button and keep it pressed for 3s.
- Keep it pressed while the LED blinks once.
- Keep it pressed while the LED blinks twice.
- After the LED "reverse-blinks" once, release the Tap Button.
- The LED will "reverse-blink" once again quickly and preset 1 is now saved.

To save preset 2 you must:

- Push the Tap Button and keep it pressed for 3s.
- Keep it pressed while the LED blinks once.
- Keep it pressed while the LED blinks twice.
- Keep it pressed while the LED "reverse-blinks" once.
- After the LED "reverse-blinks" twice, release the Tap Button.
- The LED will "reverse-blink" twice again quickly and preset 2 is now saved.

Keep in mind that, unfortunately, the Feedback setting in delay circuits cannot be saved since it's not controlled by the Bontempo.
Furthermore, the double time toggle cannot be saved in presets but will still affect the tempo even when a preset is recalled. This applies for the clean mode too.

The tempo (tapped or set with a potentiometer), the tempo division, the modulation speed, modulation depth and modulation waveform can be saved and recalled at will.
The recalled tempo will not take the clean mode into account.

Once you recall a preset, any parameters can be changed without affecting the other preset's parameters.

11 Tempo Save

When you tap a tempo it is saved on the Bontempo's EEPROM. This means that if you power down the Bontempo while a tap sequence is active, the Bontempo will resume this sequence when powered up. This is true even if some parameters are moved when the Bontempo is powered down.

12 Clean Mode

The clean mode limits the maximum tempo to 600ms. This will produce a less distorted delay. This will emulate a 50kΩ time potentiometer, like some PT2399 delay.

To activate the Clean Mode, you need to:

- Make sure the chip is powered down.
- Press the Tap Button.
- Power Up the Bontempo while keeping the Tap Button Pressed.
- Keep the button pressed until the Tempo LED blinks once.
- You now have 2s to release the button, the LED will blink once again quickly.
- You are now in Clean Mode.

This status is written in the chip's EEPROM. This mean the Bontempo will boot in clean mode every time. To deactivate Clean Mode, just repeat the procedure above. The chip will now boot in normal mode every time.

13 Deactivating Modulation

If you don't wish to use the modulation features, just connect Waveform Select Pin (Pin 6), Modulation Depth (Pin 10) and Modulation Speed (Pin 11) to ground.

Do not disconnect the BS170 MOSFET !

The MOSFET is still used by the Bontempo to compensate the Delay Time imprecision. Discarding the MOSFET will result in extremely imprecise tap sequences.

14 Digital Potentiometer SPI Interface

The only digital potentiometer guaranteed to work are the MCP41100 and MCP42100. They are 8bit 100kΩ SPI controlled digital potentiometers. The SPI interface requires 3 pins (Clock, Data and Chip Select). Since the potentiometer is 8bit, it has 256 different wiper positions. This limits the tempo precision to approximately 5ms. This imprecision is normally compensated internally by the MOSFET to reduce it to 1ms. For more information about the digital potentiometers see the datasheet.

Please be careful with the connection between the digital potentiometer and the PT2399, as the PT2399 is sensible to noise and this could throw off the calibration. Keep the connection short and direct.

15 PWM Output

Modulation and precision compensation on the Bontempo is achieved by outputting a voltage to a BS170 MOSFET in series with the digital potentiometer. The PWM frequency is 1kHz, since this frequency is the audible spectrum, we need to filter it. If a filter is not used it will result in some ring modulation in the modulated delay signal.

The chip is calibrated with a first order filter composed of a 1kΩ resistor and a 10μF capacitor. The 1kHz is reduced by 36dB by this filter, which is sufficient to the ring modulation inaudible.

16 Dual PT2399 Operation

If you wish to use the Bontempo in a dual PT2399 design, the Double Time Toggle Pin will become a "Half-Time Toggle Pin". If you don't wish to use this feature dynamically, just connect Pin4 to Vcc.

17 Tempo LED

When the delay time is controlled by the Delay Time input the LED will stay on.

When tapping a tap sequence, the LED will blink exactly when you press the tap button, beginning with the second press.

When the Tap Tempo is active, the tempo LED will blink in sync with the tempo you tapped regardless of the tempo division selected. During the blinking phase, the LED stays on for 8ms.