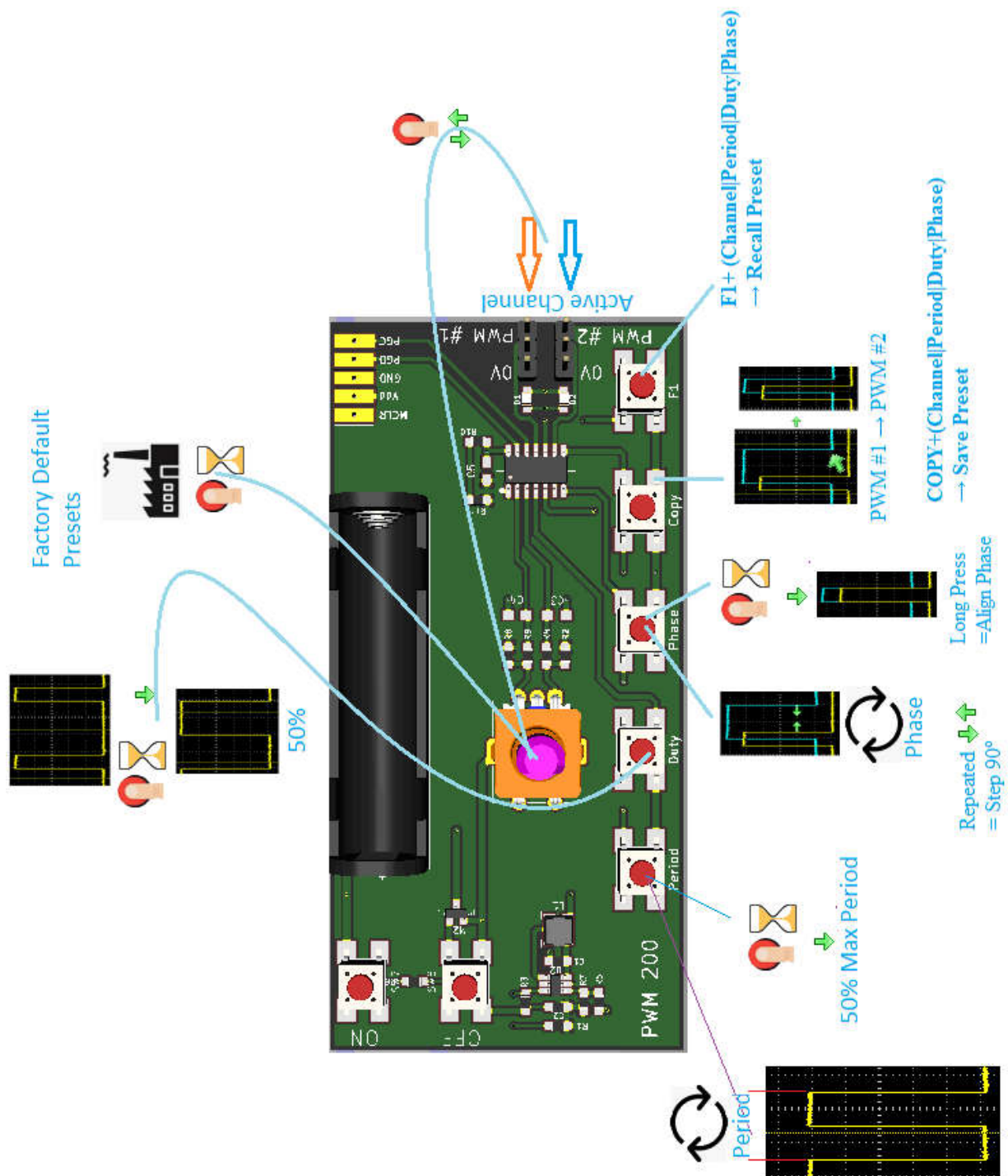


# PWM 200 r01 User Guide



## Accuracy

Figures quoted later are nominal values (within a few %). The on-chip oscillator is an RC type, and as such there will be some drift.

Typical tolerances are

Tolerance	Conditions
±2%	0°C ≤ TA < +60°C
±3%	60°C ≤ TA < +85°C
±5%	-40°C ≤ TA ≤ +125°C

## Period/Frequency Ranges

If the PWM period is moved to a frequency outside of the current range, an LED blinks briefly, the range scales by x2 (or /2) automatically – and both channels are affected by this scaling in the same way.

An LED blinks briefly when the range changes, **both PWMs are now in a new range**. Both LEDs blink when no further ranges are available in the direction chosen.

Consider adjusting PWM 1 for longer period. When the longest period in the current range is exceeded, a lower range is enabled (if available). This allows further expansion of the period. [However the other PWM is also subject to the new range, thus its period will double.](#)

When a new range is entered, **both** channels are affected. [Channel A's period always lies in the same range as channel B.](#) This is because range affects the micro-controller system clock and both PWMs are part of the micro-controller. A summary of range limits is shown below.

Range #	Max. Frequency, Hz	Min. Frequency, Hz
13	8000000	31250
12	31008	15625
11	15504	7813
10	7752	3906
9	3876	1953
8	1938	977
7	969	488
6	484	244
5	242	122
4	121.1	61.0
3	60.6	30.5
2	30.28	15.26
1	15.14	7.63

To emphasise - It is **not possible** to have PWM#1 = 8 MHz (range #13), PWM #2 = 20 kHz (range #12) because these lie in distinct ranges. It is however possible to set PWM#1 = 4 MHz, PWM #2 = 40 kHz because both frequencies are in range #13.

As another example: If PWM #1 = PWM #2 = 5kHz, then if you reduce PWM #1 to below 3906 Hz (bottom of range 10), PWM #2 will jump to  $5\text{kHz}/2 = 2.5\text{kHz}$  (and an LED will blink briefly). Again, the issue is the two channels are limited to the same frequency range.

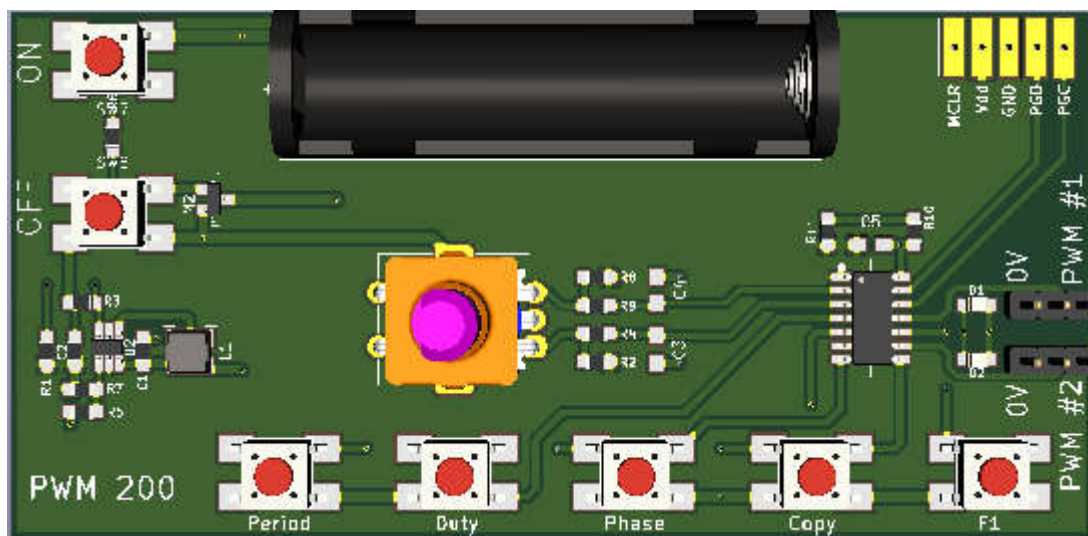
With the exception of the top range, the maximum frequency for a given range changes by a factor of 2 for each successive range.

There are over 1700 spot frequencies available.

Controls affect the currently selected channel – indicated by an LED.

A PWM source is 'period-centric', so expect smoother control of period than frequency. A setting of half way through a range is half way through the span of periods. A clockwise turn produces a longer period (lower frequency).

The user interface consists of 5 multi-function buttons and a rotary encoder (this has its own push-button). The 'finger' connections are for factory use.



### The 100% and 0% Duty Issue

When duty is adjusted, two constraints are enforced

- Duty < period (prevents 100% duty)
- Duty > 0 (prevents 0% duty)

However, it would (potentially) be possible to change period such that (duty  $\geq$  period). Therefore, when the period is adjusted, duty is automatically set to 50%. In general, specify period first, then duty.

## Resolution

**Resolution is strongly dependent upon frequency.** For instance at maximum frequency (only 1 clock cycle in 1 PWM period), an increase in period of just 1 clock cycle is a 100% change in period (2:1 **ratio**). The period doubles and the frequency halves. However, when the period is defined by 100 clock cycles, a change in period of 1 clock cycle is only a 1% change in period.

To permit as high a frequency as possible, the top range produces 8 MHz using the above scheme. This means the next step is 4 MHz. The top range has the widest range. All other ranges have a much finer first step (as a % of the first value). So for example range 12 starts with these frequencies: 31008, 30769, 30534, ...

## Features

In a given range, the two independent channels offer

- Adjustable period
- Quickly set to 50% period
- Quickly set to 50% duty (square wave)
- Finely adjustable duty
- Quickly set to 0° phase shift between channels
- Finely adjustable relative phase
- 90° phase step option
- Leading edges of channels can be synchronised
- Copy settings to other channel

There are 4 user-definable PRESET values – both channels are stored in one preset.

## Channel Selection

Change channel with the encoder's push-button. The current channel is indicated by the appropriate LED.

## Period

### **Brief Press → Period Mode**

The desired period is adjusted with the rotary control.

**At a range boundary** one of the LEDs will blink. For instance, as the period is made longer (lower frequency), there comes a point where the period cannot be made longer within the current range. In this case, the channel 1 LED will flash (irrespective of current channel). Both PWMs are scaled by 'x' or '/' 2. See “***Changing Range***” below.

### **Long Press → Default Period**

A long press on <period> sets the period to range centre; duty is set to 50%.

## Duty

### **Brief Press → Duty Mode**

Set the desired duty by adjusting the rotary control.

### **Long Press → 50% Duty (Square Wave)**

A long press on <duty> sets the duty of the selected channel to 50%.

## Phase

### **Brief Press → Phase Mode**

Set the desired phase by adjusting the rotary control.

### **Further Brief Presses → Phase Step**

Once already in phase mode, advances channel B by 90°.

### **Long Press → Leading edge synchronisation**

A long press on <phase> aligns channel B's leading edge to channel A's leading edge.

## Copying Channel settings

Press <copy> to clone the current channel configuration to the other channel.

## Presets

The user presets are associated with these push-buttons

1. Encoder
2. Period
3. Duty
4. Phase

As shipped, the unit holds factory default values. These defaults can be restored (see later). **The power-on settings stem from preset #1 (encoder).**

To recall a preset

- Press and hold <F1>
- Press any of the preset keys
- Release <F1>

To save current settings into a preset

- Press and hold <Copy>
- Press any of the preset keys
- Release < Copy >

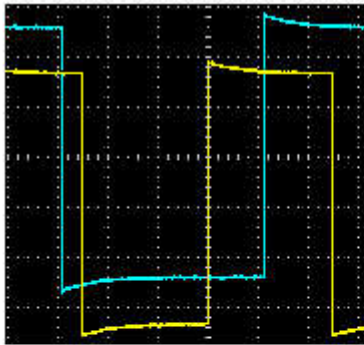
To restore factory default preset values

- Press and hold <Encoder>

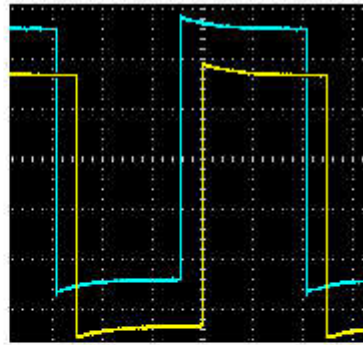
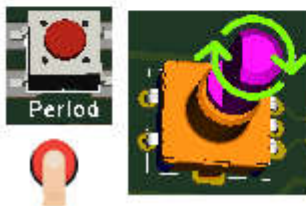
## Quadrature

To configure 2 waves in quadrature (90° phase difference), follow these steps.

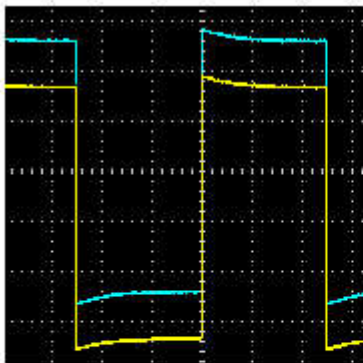
1. Tune PWM #1 to the required frequency.
2. Press <Copy>. Both channels are now emitting the same frequency.
3. Press and hold <Phase>. Leading edges are now aligned.
4. Briefly press <Phase> once. The phase now steps by 90°.



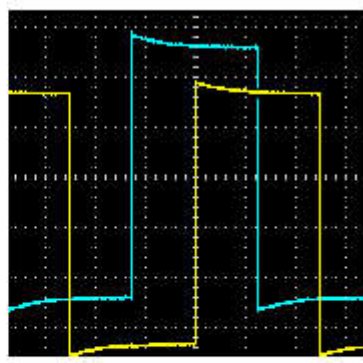
Step 1



Step 2



Step 3



Step 4



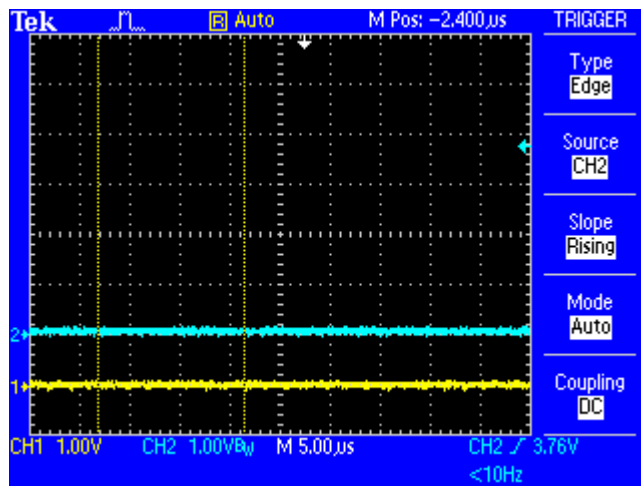


Fig. 1

No signal. Note the deliberate offset for clarity.

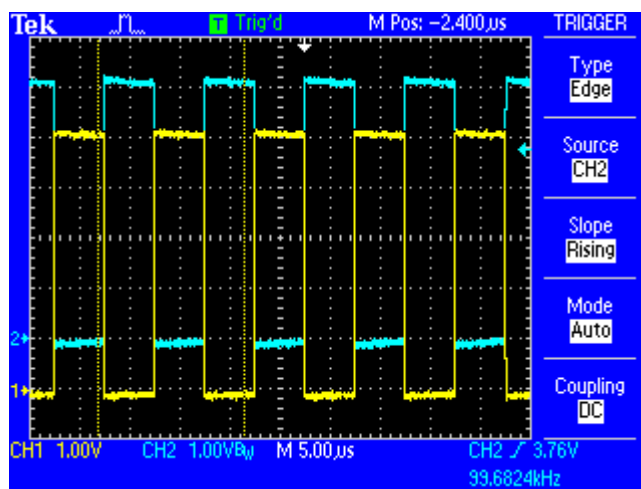


Fig. 2

Factory default – Preset #1.

Preset #1 is the power-on start-up configuration.

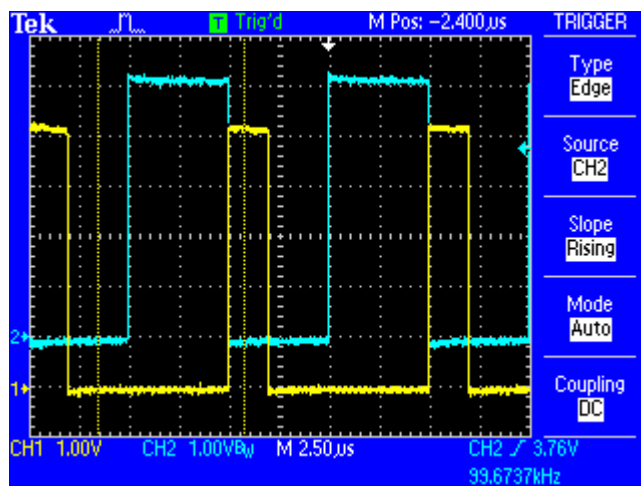


Fig. 3

Shows adjustment to PWM #1 duty

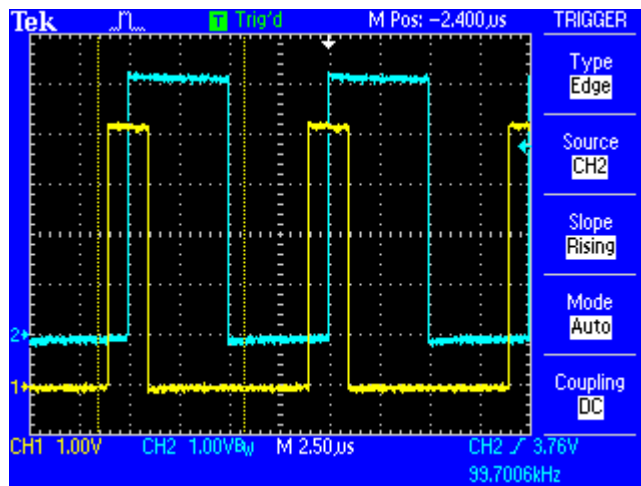


Fig. 4

Arbitrary control of phase shift

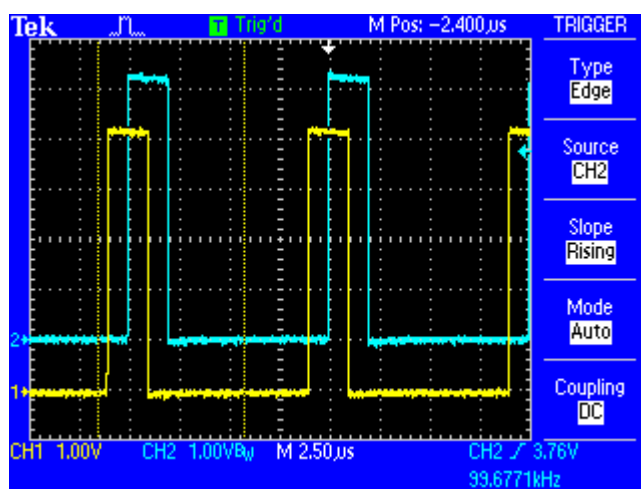


Fig. 5

After copying PWM 1  $\rightarrow$  PWM 2

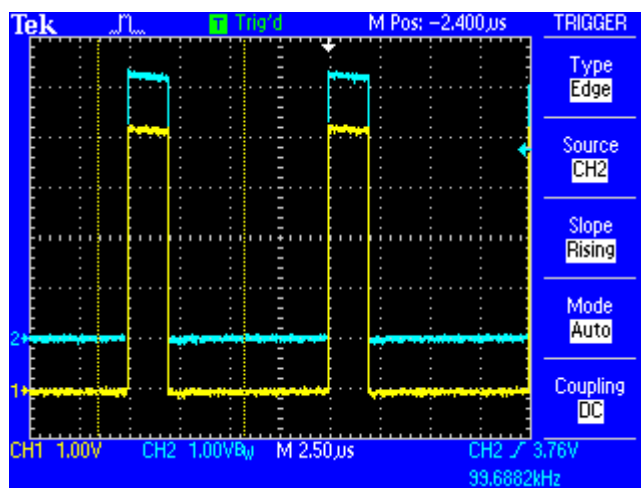


Fig. 6

Following phase align

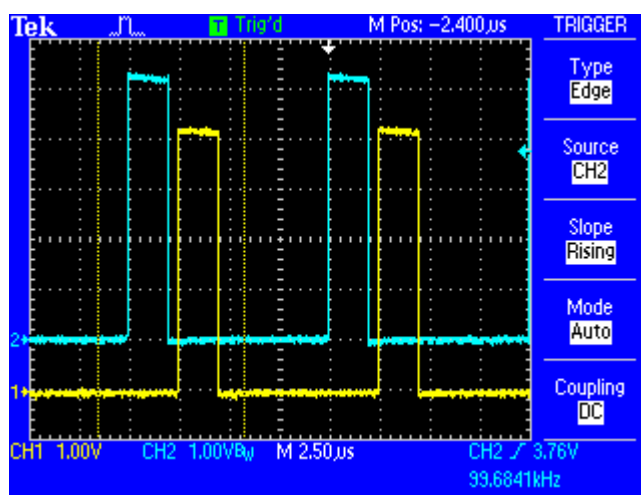


Fig. 7

After 90 degree phase step



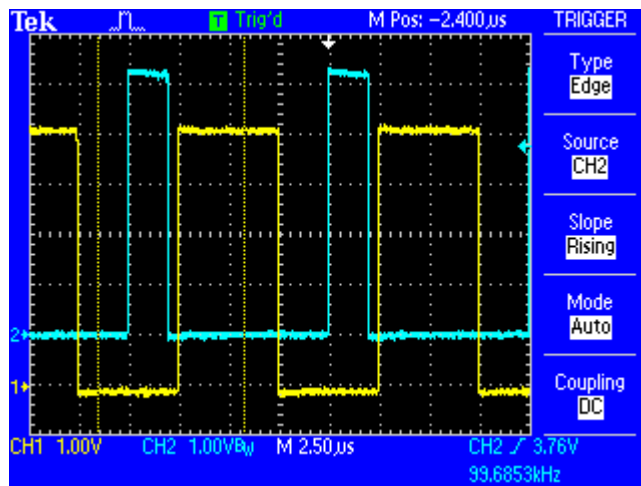


Fig. 8

50% Duty