PWM SOCKET

What is PWM(Pulse Width Modulation) ?

Before the pulse width modulation, it would be useful to talk about brake systems in vehicles. ABS brakes, as known, prevent the wheels from skidding, thus ensuring that steering is not lost. This can also be achieved by pressing the brakes on the wheels, not in continuous pressure, but in the form of pulses. While stopping at normal braking takes longer and need more heat energy, also with this the steering wheel is also lost, the ABS braking is provided with less heat energy and more reliable maneuvers in less time.

Pulse width modulation could be like ABS brakes. With the help of special circuits, it is called pulse width modulation. Pulse width modulation is done by adjusting the duration of the voltage when the voltage is continuous or interrupted.

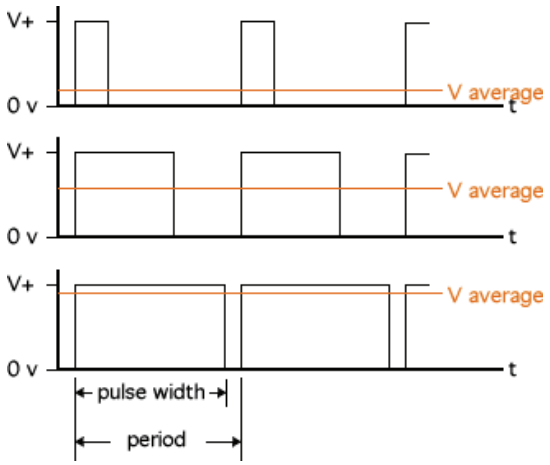


Figure 1. Pulse examples

Figure 1 shows the pulse examples. As seen here, peak values (amplitudes) of the pulses do not change. Changing is only the times of the width of the pulses. The output is the Vaverage value which is the average value of these pulses. It is the switching process that determines the times here. Depending on the elements used in the special circuits installed, a switching frequency is determined. Again, the pulse width is set by the elements in the circuit .The specified frequency and the specified width operation are provided.

The ratio of the pulse width, that is, the continuous duration of the pulse, to the period gives the ratio called the Duty Cycle. With this ratio, the adjustment can be made between input voltage and output voltage. The power transferred to the output with Duty Cycle is directly proportional. That is, the lower the Duty Cycle, the lower the power transferred to the output.

How is Pulse Width Modulation Implemented in the Solenoid Valve?

The inductance element L draws a current as in Figure 1 at the direct current. After a certain delay, the current sitting on the stable structure only affects the resistance of the inductance. From the moment of zero to the moment the stable structure is formed, the coil provides the required magnetic force, pulls the core, and then the current acts on the resistance of the coil. The power consumed here is only spent on heating in the winding.

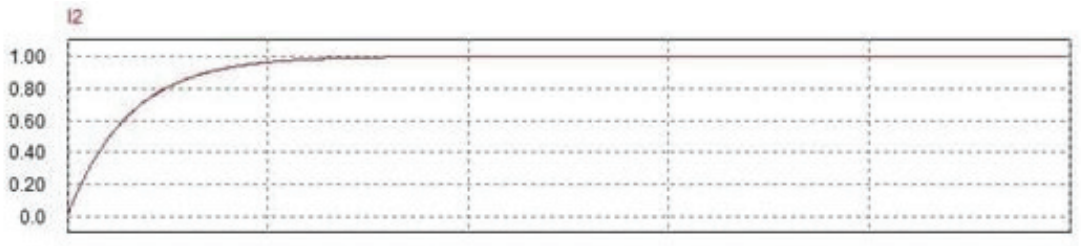


Figure 2. Current wave form of L element in direct current

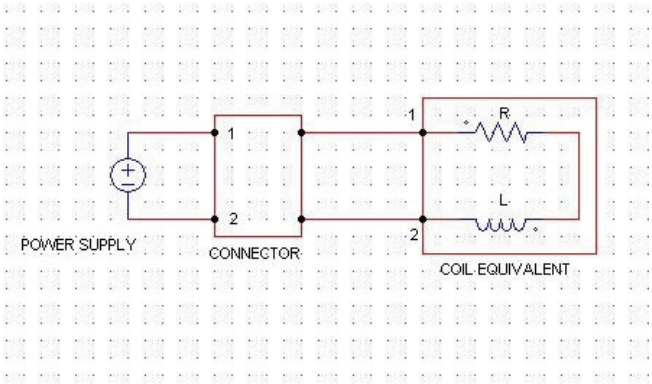


Figure 3. Solenoid coil operating circuit

In order to save lost energy in coils running with direct current; After providing the necessary magnetic force to hold the core, the voltage level can be adjusted by Pulse Width Modulation. Electronic circuits are provided for that.

Due to the delay time of the socket, coil has time for pulling the core. After the core has been drawn, less energy is needed to keep the core in this position. The PWM socket provides enough power to hold the core up. This saves energy.

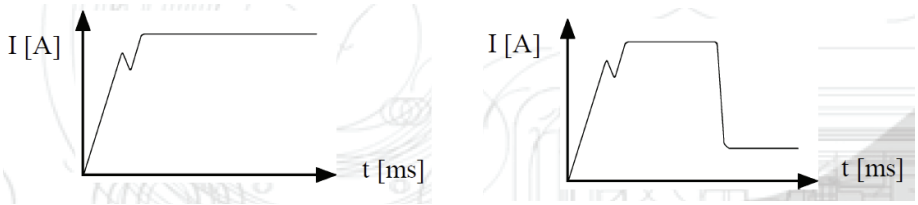


Figure 4. Current wave forms. (A) Without PWM socket, (b) with PWM socket

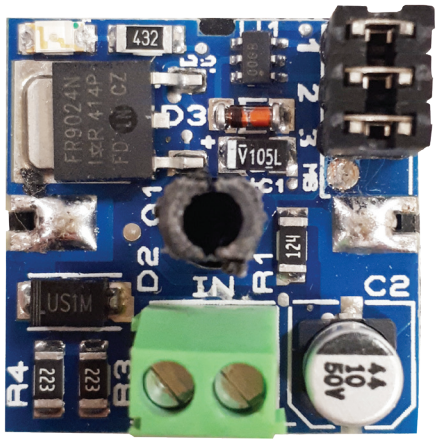


Figure 5.Socket electronic circuiti

There are 3 jumpers on the TORK PWM socket's electronic card which saves energy in the solenoid coils. The jumpers are numbered 1, 2 and 3. The PWM ratio is set according to the status of the jumpers on the card.

Program	1	2	3	4	5	6	7	8
SW1	0	1	0	1	0	1	0	1
SW2	0	0	1	1	0	0	1	1
SW3	0	0	0	0	1	1	1	1
Mark Raito (On:Off)	1:8	2:7	3:6	4:5	5:4	6:3	7:2	8:1
Duty Ratio	11%	22%	33%	44%	56%	67%	78%	89%

Table 1. PMW ratios according to jumpers status

In this study, PWM ratio is 67% .

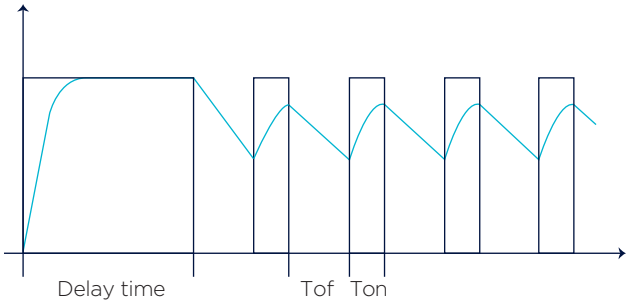


Figure 5. PWM socket voltage-current wave form

The wave forms shown in Figure 5, blue is voltage wave form and the yellow is current wave form. As can be seen, the voltage is in the form of pulses. The current is continuous. It is expected that a similar shape will be obtained in the experimental study.

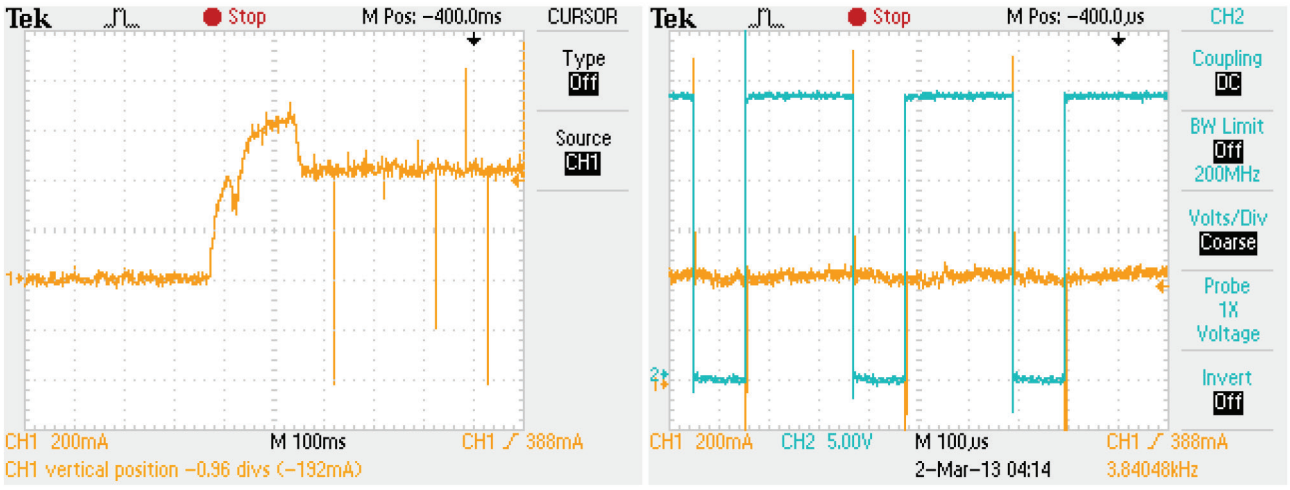
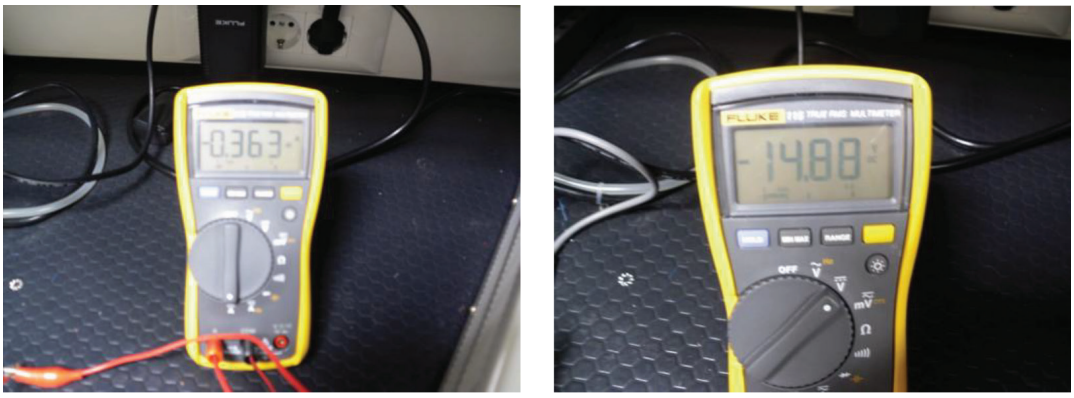


Figure 6.Voltage-Current waveforms

Figure 6 shows the current-voltage waveforms. The lead time in the form of the initial current wave is also seen. The voltage pulse shape can be seen later. The current flowing during the toff is the current of the protection diode in the electronic stream.



(a) (b)

Figure 7. Values measured on the coil: **(a)** Current value, **(b)** Voltage value.

What are the advantages of PWM socket?

Since pulse width modulation is done at the output voltage with PWM socket, the excess energy consumed is saved. Thus, the heatenergy consumption decreases and coil heating problems would be solved. Thus, less heated coils will have a longer service life. Also in the PWM socket, the protection diode is added to the system to prevent reverse current flow through the coil.

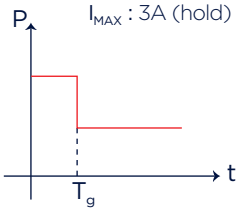
On Which Solenoid CoilsPMW Sockets Can Be Used?

The PWM socket can be used in coils that work at voltages between 12-48VDC, maximum 3A as the holding current and up to 8A (1sec) as the draw current. It can be used in hydraulic coils operating under these conditions as long as the socket size is suitable. The same application may be theoretically possible for mini coils, but the size of the mini sockets is not suitable for this type of application. In addition, because the mini coils operate with low energy, there is no need for PWM application.

Label Information

Jumpers			Duty Ratio
3	2	1	
0	0	0	11%
0	0	1	22%
0	1	0	33%
0	1	1	44%
1	0	0	56%
1	0	1	67%
1	1	0	78%
1	1	1	89%

T_g : 150ms
f : 2.8kHz
V_s : 12-48VDC
I_{MAX} : 3A (hold)



Kod: C82012048VDC

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