Northwestern Polytechnic University

EE468 – Microelectronic Circuit Design and Analysis

PLO Signature Assignment

MSEE Program - 2020 Summer Semester

Project Title: Single Phase Motor Driver

(use a FET H-Bridge topology)

Assignment Prepare By:

Name: Chang Pao Herr

Student ID: 19544

Email: changherr@gmail.com

What is an H-Bridge? As found in research in this topic, H-Bridge is an electronic circuit that switches the polarity of a voltage applied to a load. The H-Bridge got it names from a graphical representation of the circuit form. The circuit are often used in robotic, motors to run forwards or backwards, a stepper motor is a good physical example. The H-Bridge circuit is served at the final stage prior amplified the signal power to a motor. Multiple series of integrate circuits are implemented before the signal gets amplify out; some of most common circuit include is pulse width modulation (PWM), self-oscillator circuits such as RC, LC and Crystal oscillator. Each of the circuit generates different type of wave forms to meets the need for designs required, often sine and square wave oscillating circuit are among the most popular used for motor drive.

In general H-Bridges are available as integrated circuits, or can be built from discrete components. An H-bridge is built of four switches that control the flow of current to a load. In the image below, the load is the M connecting the two sets of switches. Using one current source, you can drive current in two directions by closing two switches.

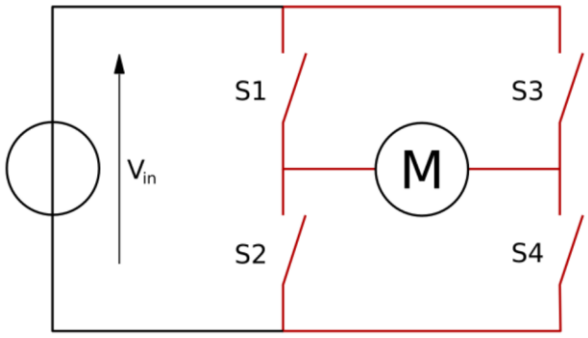

Figure 1: Structure of H-Bridge topology

Self-oscillator circuits as RC, LC and Crystal oscillator are also common use for a self-oscillated wave form to the H-Bridge. The frequency waveform circuit typical start from the crystal oscillator and pass thru the RC and LC circuit to the H-Bridge. Below is a similar circuitry illustrating typical use.

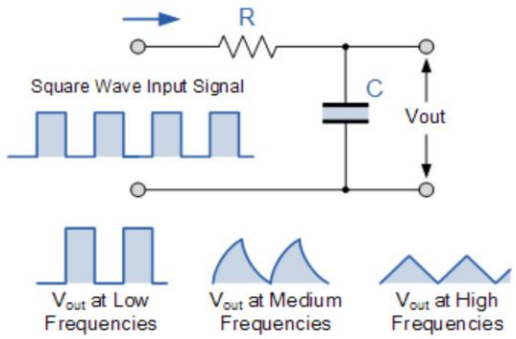

Figure 3. RC circuit waveform generate diagram

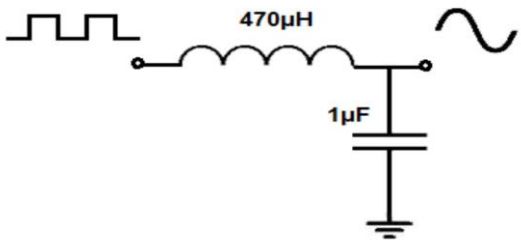

Figure 4. LC circuit waveform generate diagram

The most common use and easy to control the waveform is pulse width modulation (PWM) that can be easy way to design using from a LM555 timer PWM to high performance pulse width modulator control as SG1526/SG2526/SG3526/SG3525. Below is typical PWM circuit using the selected IC.

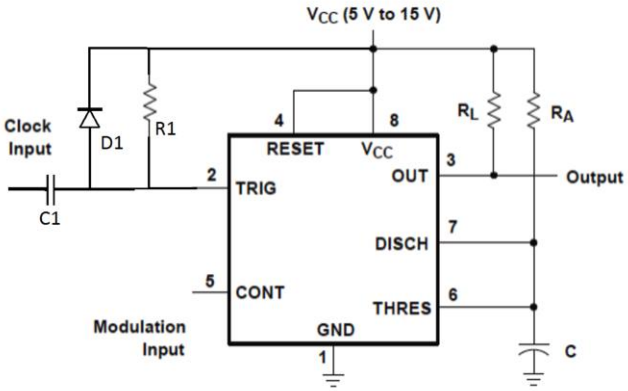

Figure 2. PWM signal circuit diagram using LM555

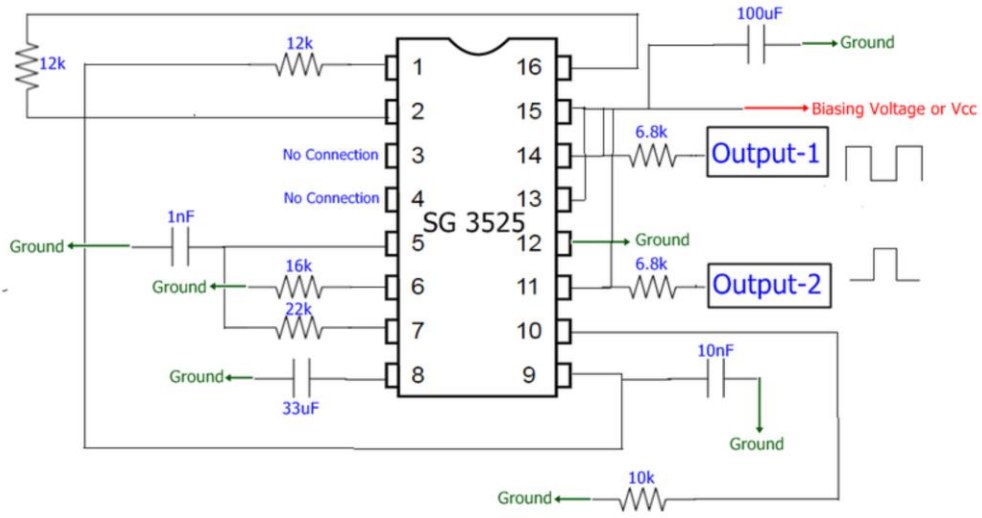

Figure 3. PWM signal circuit diagram using SG3525.

H-Bridge in circuit is commonly use of 4 N-Channel Transistor or MOSFET to generate the output waveform. They are many ways of putting the circuit together to drive the H-Bridge and some of the most popular and better protection intern of reliability is using a driver IC or a gate drive transformer to drive the MOSFET.

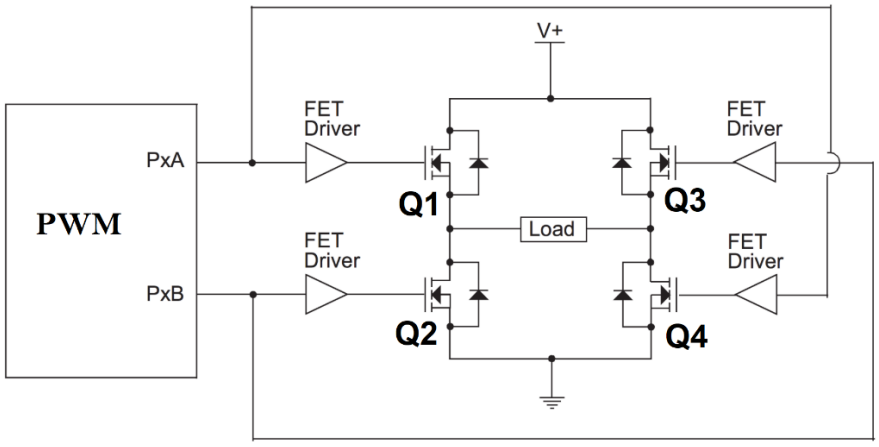

Figure 4. Typical H-Bridge circuit diagram

The PWM output the waveform and goes into a driver IC, this waveform signal can also be connected to the gate drive transformer and the secondary will turn on/off the MOSFET. The waveforms can be illustrated as show in figure 5.

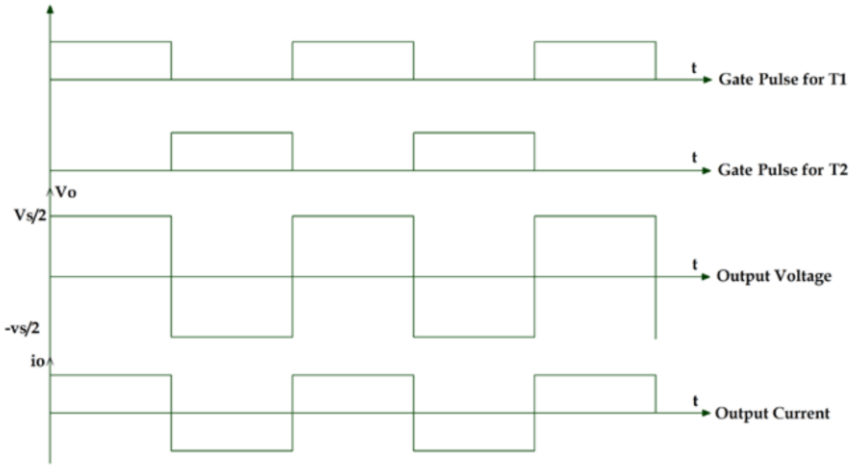

Figure 5. Typical H-Bridge waveform diagram

As of the four FETs are switching and the output is loading the voltage and current are working accordingly when switch S1, S4 are closed and S2, S3 are open then the positive voltage will be applied across the motor and the motor will be run in the forward direction. In this case, the direction of flow of current is indicated in the below circuit diagram. When switch S2, S3 are closed and S1, S4 are open then the negative voltage will be applied across the motor and the motor will be run in the backward direction. In this case, the direction of flow of current is indicated in the below circuit diagram.

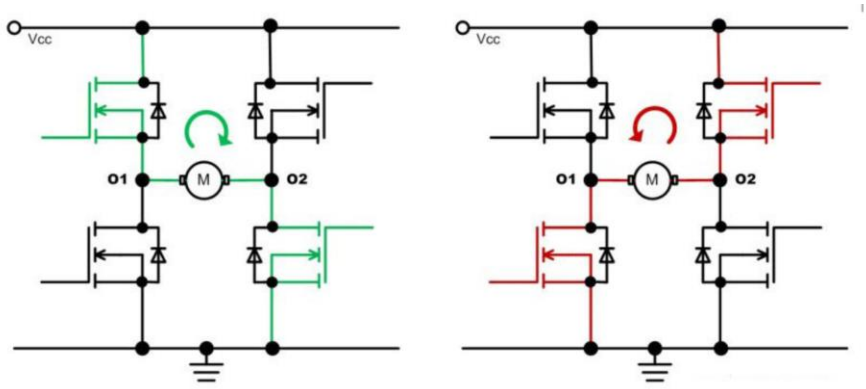

Figure 4. Typical H-Bridge switching direction

Rubric PLO#1:

Features	Goal/Design	Accomplished
Integrated reporting:	Option use of IC Chip:	
	KA7552A/KA7553A – Programable Chip	Used code to design output modulate pulse as desired to all performance interface.
	LM555 Timer – IC available in small package	Easy design for simple hobby project to drive motor or robotic.
	SG1526/2526/3526 – IC available at higher level	High level use in most industry IC, this IC can be to drive motor, transformer, and other application as voltage converting such as DC/DC, DC/AC.
Content Development:	Use basic of MOSFET, Transistor, Resistor, Capacitor, IC as listed above.	Complete the H-Bridge switching output to drive motor and transformer.
Syntax & Mechanics:	VHDL Verilog, C++, Java code	Stable controls of the pulse modulation signal and monitor status
	Electronic parts: motors, displays, keypad.	Need schematic, harness, to build controls and functional control of the motor and transformer
	Mechanics: Housing and enclosure design assembly from draftsman	Assembly kits, installation kit,
Evidence:	Test result and qual implementation document	Proof of working product and data sheet
Decisions/Outcomes:	Implementing to production use	Need approval of design/production team

Rubric PLO#4:

Features	Goal/Design	Accomplished
Determine the Extent of Information Needed	Expert and consultant to complete the project	Evaluate the project and get it passed industrial standard code specification
Access the Needed Information	N/A	N/A
Evaluate Information and Sources Critically	Survey and sale personnel	Customer demand and sale increase
Use Information Effectively	Product Website, Brochure and Handout, User Manual	Get the product name out there and ease of product getting to consumers.
Access/Use Information Ethically/Legally	Pattern the product	Legal of product usage to consumers