## **EDULABS DIDACTIC**

# POWER ELECTRONICS TRAINER

## **EXPERIMENT 26**

## **EXPERIMENTS MANUAL**

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#### **Objectives:** The trainee is able to

- 1. Acquaintance the principle of H-Bridge converter
- 2. Measure the quantities and direction of output voltage and current

#### **Experiments Lists**

- 1. Experiment 26.1: The output voltage of H-Bridge converter
- 2. Experiment 26.2: The output current of H-Bridge converter

#### Theory

The H-Bridge converter is a double direction output current converter and adjustable output voltage. The circuit diagram of H-Bridge consists of two IGBT circuits (T1-T3 and T2-T4) as shown on fig. 26.1. To prevent the short circuit each IGBT is fired separately.

The H-Bridge converter is control by firing pulse of the duty cycle and the direction of current will be assigned by the ON time of each IGBT, if firing the T1 and T2 current will flow from left side to right of the picture, on the contrary the direction of current will flow from right to left if the T3 and T4 are operate. The quantities of output voltage can be varying by control the ON time of IGBT.



Figure 26.1 the H-Bridge converter circuit

#### **Equipment Requirement**

No.	Item	Model	Quantity
1	Group of Diode Module	EM-21-01-03	1
2	IGBT Chopper / Inverter Chopper	EM-21-01-11	1
3	PWM Controller	EM-21-02-03	1
4	Resistive Load Module (I)	EM-21-03-01	1
5	Capacitive Load Module	EM-21-03-03	1
6	Three Phase AC Power Supply	EM-21-04-01	1
7	DC Power Supply	EM-21-04-02	1
8	4mm Safety Stackable Connecting Lead Set	EM-21-12-01	1 Set
9	DC Voltmeter	EM-30-13-01	1
10	DC Ammeter	EM-30-13-02	1
11	4mm Stackable Connecting Lead Set	EM-30-15-12	1 Set
12	19mm Shunt Plug Set	PTL-2170	2
13	Digital Storage Oscilloscope	TDS-2102C	1

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#### Procedure

### **Experiment 26.1: The output voltage of H-Bridge converter**

1. Construct the circuit according to circuit diagram Figure 26.1.



2. PWM Controller setting:

## - Frequency Range = X10 (CHANGE FROM X100 TO X10 TO PREVENT HIGH CURRENT FLOW WHEN ADJUST THE HZ KNOB TO MAXIMUM, TRNAFORMER OUTPUT CURRENT MAY UP TO 1.5A AC AND BURN THE TRANSFORMER (0-45VAC)

- Frequency Adjust = 200Hz

- 3. Connect the voltage supply  $\pm 15$  V to PWM controller.
- 4. Connect S1 of Q1 to S1 of PWM controller.
- 5. Connect S4 of Q4 to S4 of PWM controller.
- 6. Connect S2 of Q2 to S2 of PWM controller.
- 7. Connect S3 of Q3 to S3 of PWM controller.
- 8. Adjust the duty cycle of PWM generators at  $t_{on} = 0\%$  in **forward mode**.
- 9. Turn ON power supply for PWM Controller before rectifier circuit.
- 10. Measure and record the quantities and direction of output voltage in Experimental Table 26.1.1;
- 11. Change the duty cycle as  $t_{on} = 0\%$  in **reverse mode** to measure and record the corresponding voltage in Experimental Table 26.1.2, relatively;
- 12. Turn OFF power supply.



Figure 26.1 Circuit diagram for measure the output voltage

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## **Experimental Table 26.1.1**

Duty Cycle (%)*	<b>Vo</b> (V)	<b>Direction</b> (+/-)	Waveform at Load
0			
20(F)			
40(F)			
60(F)			
80(F)			
100(F)			

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## **Experimental Table 26.1.2**

Duty Cycle (%)*	<b>Vo</b> (V)	<b>Direction</b> (+/-)	Waveform at Load
0			
20(R)			
40(R)			
60(R)			
80(R)			
100(R)			

Note\*: Adjust in approximate scale.

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## Expected Result Table 26.1.1

Duty Cycle (%)*	<b>Vo</b> (V)	<b>Direction</b> (+/-)	Waveform at Load
0	0		■ 27-Mar'19 6:28 Trigd T MEASURE Frequency 1:2.208kHz 2:chan off Vpp 1: 1310 2:chan off Vms 1:48.10 2:chan off Vmin 1:-64.00 2:chan off Period 1:452.8us 2:chan off Main 1:452.8us 2:chan off CH1 EDGE ✓ 2.17437kHz CH1 = 200 CH2 ==50 CH3 ==50 CH3 ==50 CH3 ==50 CH4 ==50 CH
20(F)	7	-	•@•         27-Mar'19         6:31         Trigd _m         MEASURE           Frequency         1:2.477kHz         2:chan off         Ypp           1:         1280         2:chan off         Yms           1:         1:280         2:chan off         Yms           1:         1:51.50         2:chan off         Ymin           1:-64.00         2:chan off         Ymin           1:-794ms         2:chan off         Ymin           1:1.794ms         2:chan off         Ymin           1:1.794ms         2:02624kHz         Ymin           CH1         2:0         CH2         SU
40(F)	13	-	•œ•         27-Mar'19         6:31         Trigd J™L         MEASURE           Frequency         1:2.004kHz         2:chan off         2:chan off           1:         1200         2:chan off         Vms           1:         1:57.00         2:chan off           2:chan off         Vms         1:57.00           2:chan off         Vmin         1:-64.80           2:chan off         Period         1:498.9us           1:mage saved to DS0006.BMP completed         2:02849kHz           CH1         2:5ms         CH1 EDGE ✓         2.02849kHz           CH1         :=200         CH2         :=50         CH3         :=50
60(F)	25	-	••         27-Mar'19         6:31         Trigd m         MEASURE           Frequency         1:149.4Hz         2:chan off         Vpp           1:123U         2:chan off         Vims           1:30.9U         2:chan off         Vims           1:30.9U         2:chan off         Vims           1:30.9U         2:chan off         Vims           1:30.9U         2:chan off         Vimin           1:-66.4U         2:chan off         Vimin           1:-60.90         2:00432kHz         2:00432kHz           CH1 =:20U         CH2 ::::::::::::::::::::::::::::::::::::



Note\*: Adjust in approximate scale.

### **Expected Result Table 26.1.2**

Duty Cycle (%)*	<b>Vo</b> (V)	<b>Direction</b> (+/-)	Waveform at Load
0	0		•@3•       27-Mar'19       6:28       Trigd fml       MEASURE         Frequency       1:2,208kHz       2:chan off         2:chan off       2:chan off         1•       1:31U       2:chan off         1•       1:48.1U       2:chan off         2:chan off       Yms         1:48.1U       2:chan off         2:chan off       Ymin         1:-64.0U       2:chan off         0:000 s       2:chan off         0:452.8us       2:chan off
20(R)	8	+	• ◯ 27-Mar² 19         6:28         Trigit _m         MEASURE           Frequency         1:2.348kHz         2:chan off           Vpp         1:134U         2:chan off           Vpp         1:134U         2:chan off           Vistor         1:52.4U         2:chan off           2:chan off         Vistor         1:52.4U           2:chan off         Vistor         1:52.4U           2:chan off         Vistor         1:68.8U           2:chan off         Vistor         1:425.9U           0.000 s         2:chan off         2:chan off           0.000 s         2:chan off         2:chan off

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40(R)	16	+	• @ 27-Mar'19 6:27 Trigd m ME Free 1:2. 2:cr 1: 1 2:cr 1: 50 2:cr 1:56 2:cr 1:57 2:cr	ASURE           quency           .414kHz           han off           Vpp           1290           han off           Vrms           6.90           han off           Vrms           64.80           han off           Period           14.1us           han off           8329kHz
60(R)	27	+	• 27-Mar'19 6:27 Trigd m HE Free 1:14 1:14 1:14 1:14 1:14 1:32 2:cr 1: 1:2:cr 1: 1:2:cr 1: 1:2:cr 1: 1:2:cr 1:2:cr 1: 1:5:cr 1: 1:5:cr 1: 1:5:cr 1: 1:5:cr 1:5:cr 1:5:cr 1: 1:5:cr 1:	ASURE quency 49.3Hz han off Vpp 1290 han off Vrms 0.40 han off Vrms 66.40 han off Period .698ms han off 19542kHz 50
80(R)	37	+	• @ • 27-Mar'19 6:27 Trigd ML Frea 1: 2:cr 1. 1: 2:cr 2: 2:cr 2: 2:cr 2: 2:cr 2: 2:cr 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2:	ASURE quency ? han off Vpp ? han off Vmin 52.80 han off Period ? han off 21101kHz = 50
100(R)	40	+		ABOUNE quency 49.2Hz han off Vpp 8.80 han off Vrms 0.80 han off Vrmin 1.600 han off Period .702ms han off 5.951Hz 50

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#### **Experiment 26.2: The output current of H-Bridge converter**



- 1. Construct the circuit according to circuit diagram Figure 26.2.
- 2. PWM Controller setting:
  - Frequency Range = X10
  - Frequency Adjust = 200Hz
- 3. Connect the voltage supply  $\pm 15$  V to PWM controller.
- 4. Connect S1 of Q1 to S1 of PWM controller.
- 5. Connect S4 of Q4 to S4 of PWM controller.
- 6. Connect S2 of Q2 to S2 of PWM controller.
- 7. Connect S3 of Q3 to S3 of PWM controller.
- 8. Adjust the duty cycle of PWM generators at  $t_{on} = 0\%$  in **forward mode**.
- 9. Turn ON power supply of rectifier circuit and PWM Controller.
- 10. Measure and record the quantities and direction of output current in Experiment Table 26.2.1;
- 11. Change the duty cycle as  $t_{on} = 0\%$  in **reverse mode** to measure and record the current in Experimental Table 26.2.2, relatively.
- 12. Vary the duty cycle in range of 0 % to 100 % on each mode (Forward/Reverse) to observe the effect of current flow.
- 13. Turn OFF power supply.



Figure 26.2 Circuit diagram for measure the output current

## **Experimental Table 26.2.1**

Duty Cycle (%)*	Io (A)	<b>Direction</b> (+/-)
0		
20(F)		
40(F)		
60(F)		
80(F)		
100(F)		

**Note\*: Adjust in approximate scale.** EDULABS DIDACTIC

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## **Expected Result Table 26.2.1**

Duty Cycle (%)*	Io (A)	<b>Direction</b> (+/-)
0	0	
20(F)	0.04	-
40(F)	0.07	-
60(F)	0.13	-
80(F)	0.19	-
100(F)	0.20	-

Note\*: Adjust in approximate scale.

## **Experimental Table 26.2.2**

Duty Cycle (%)*	Io (A)	<b>Direction</b> (+/-)
0		
20(R)		
40(R)		
60(R)		
80(R)		
100(R)		

Note\*: Adjust in approximate scale.

## Expected Result Table 26.2.2

Duty Cycle (%)*	Io (A)	<b>Direction</b> (+/-)
0	0	
20(R)	0.04	+
40(R)	0.09	+
60(R)	0.16	+
80(R)	0.20	+
100(R)	0.21	+

Note\*: Adjust in approximate scale.

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