EDULABS DIDACTIC

POWER ELECTRONICS TRAINER

EXPERIMENT 25

EXPERIMENTS MANUAL

Experimental objectives: the trainee is able to

1. Acquaintance the principle of cycloconverters
2. Measure the output voltage on resistive load

Theory

The Cycloconverter is a direct frequency converter which converts from a fixed frequency AC input to an adjustable AC output, which **both of voltage and frequency** can adjust independently.

The circuit diagram of cycloconverter consists of two identical phase controlled thyristor converter as shown on figure 25a. Each converter circuit has the midpoint or the bridge configurations are connected to power source and they can supply a Dc output voltage of either polarity.

The first converter produce the positive half cycle of the output frequency, while another converter circuit convert yield the negative half cycle. In the case of delay angle of the two converter circuits are zero the output voltage is maximum. In the positive half cycle of supply voltage the first converters is fired and during the negative half cycle the second converter is fired.

The output voltage waveform is shown in figure 25b, which each half cycle is produce a whole number of half cycles of single phase supply waveform that decrease the frequency to one-third of the input. If the firing angle or delay angle is increase, the output voltage is reduced. Note the output voltage receives a full half cycle of an input at the peak period.

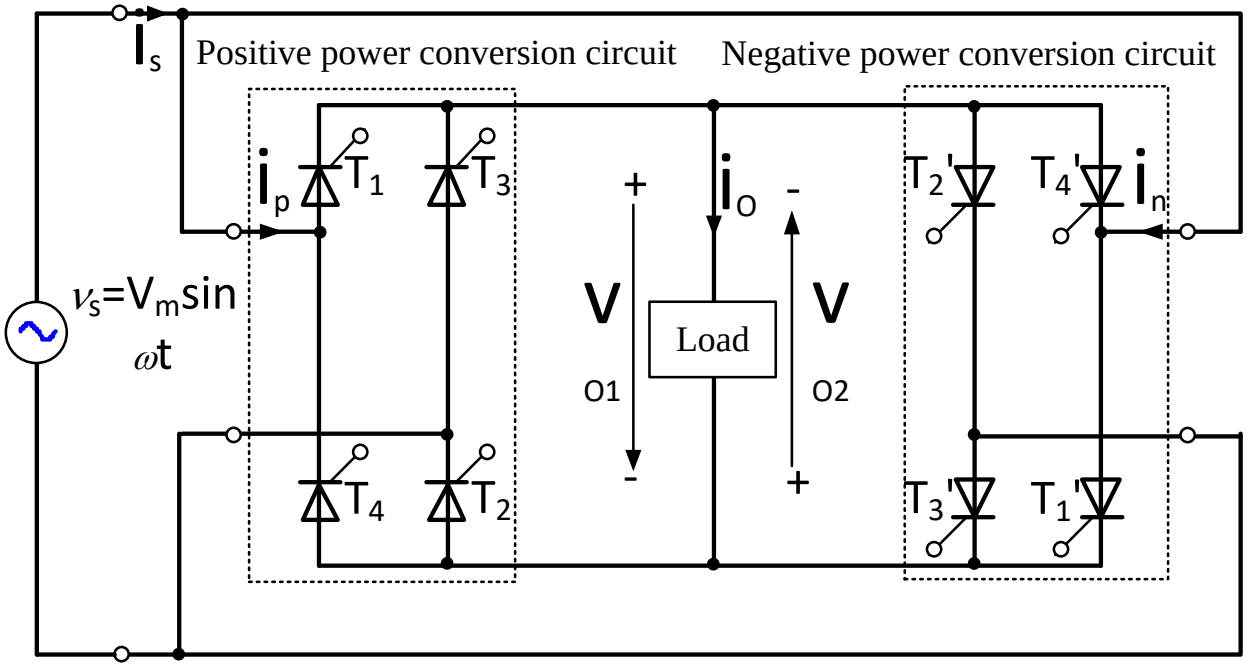


Figure 25a the Cycloconverter circuit

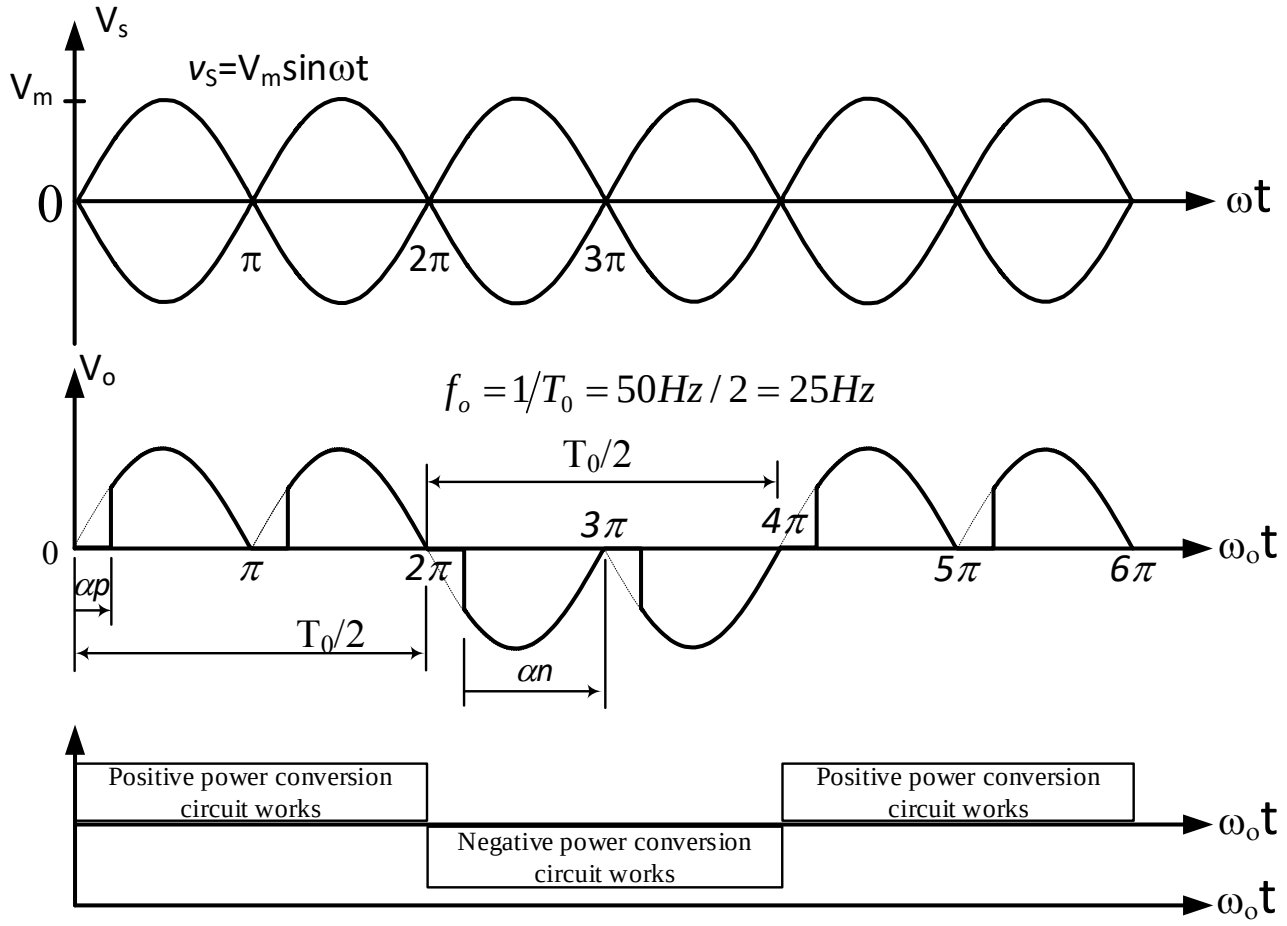


Figure 25b Output voltage of cycloconverter

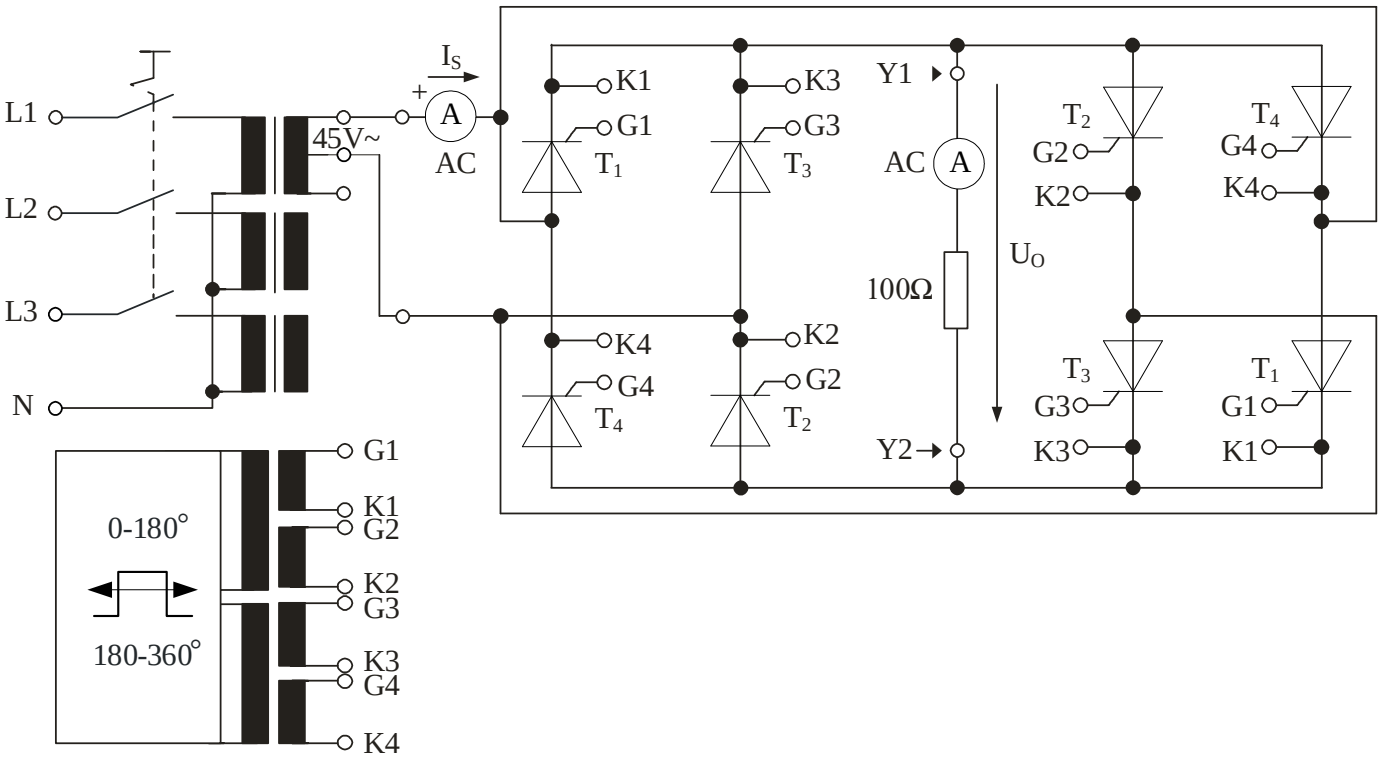
Equipment Required

No.	Item	Model	Quantity
1	Group of SCR module **(Optional 1 unit)**	EM-21-01-05	**2**
2	Two Pulse Controller **(Optional 1 unit)**	EM-21-02-01	**2**
3	Duty Cycle Phase Controller	EM-21-02-04	1
4	Resistive Load	EM-21-03-01	1
5	Three Phase AC Power Supply	EM-21-04-01	1
6	DC Power Supply	EM-21-04-02	1
7	AC Ammeter **(Optional 1 unit)**	EM-30-13-04	**2**
8	19mm Shunt / Bridging Plug Set	EM-30-15-06	10
9	19mm Shunt / Bridging Plug Set (Stackable)	EM-30-15-06	10
10	2mm Stackable Test Lead Set (Banana Plug Type) (5 color coded)	EM-30-15-10	16
11	4mm Stackable Test Lead Set (Banana Plug Type)	EM-30-15-12	3
12	4mm Safety Stackable Connecting Lead	EM-30-15-01	1 set
13	Digital Storage Oscilloscope (Optional)	TDS-2102C	1

Experiment 25: Acquaintance the principle of cycloconverters and measure the output voltage on resistive load

Procedure

1. Construct the circuit according to current diagram Figure 25.1.



NOTE: Adjust FIRING ANGLE knob to maximum 180° for 2 units Two Pulse Controller before changing the percentage of the Duty Cycle Phase Controller to prevent burning fuse.

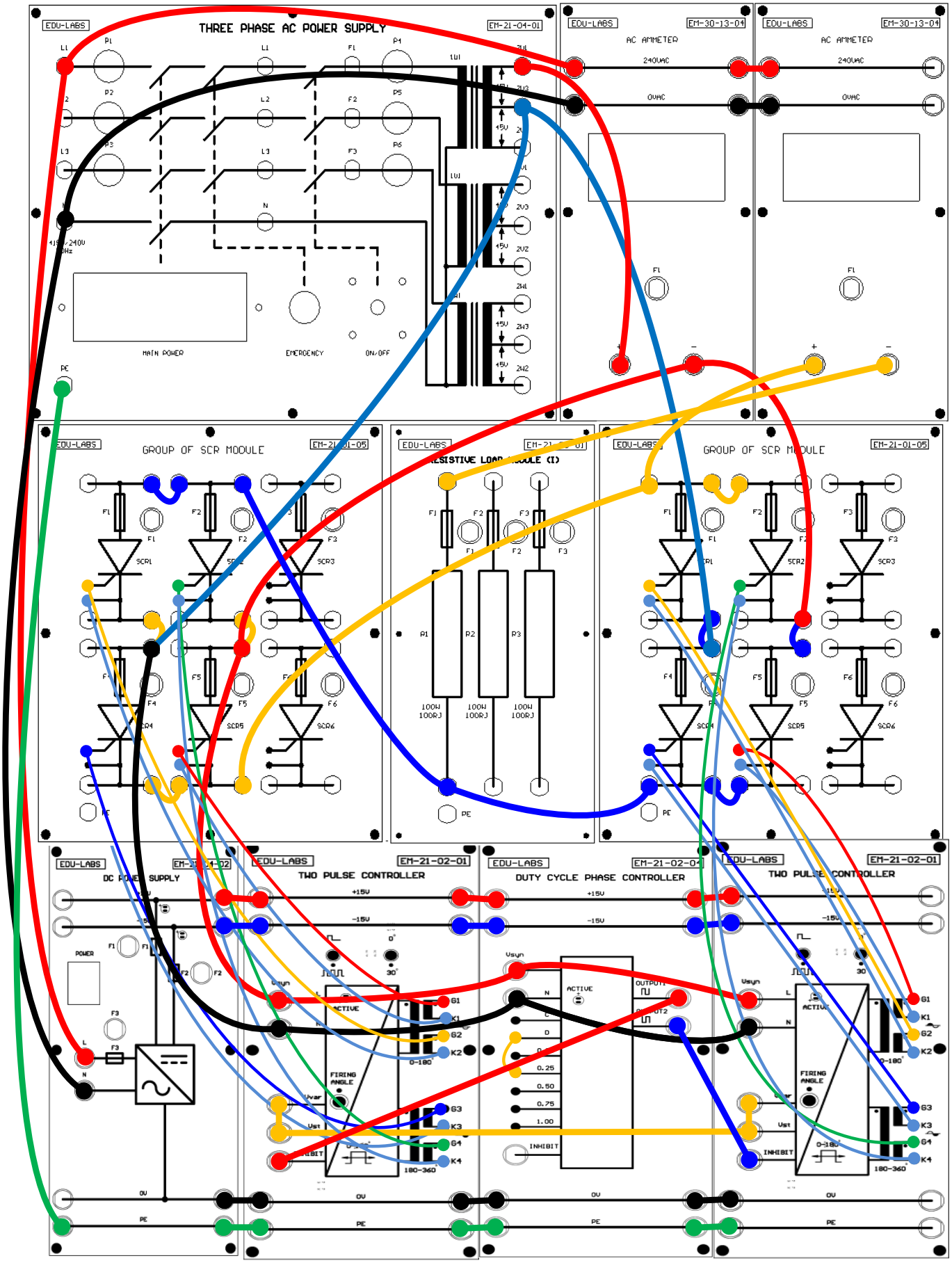


Figure 25.1 Current diagram for measure the output voltage

2. Connect the terminal of two pulse controller unit 1 to the corresponding gates and cathode terminals of SCR in rectifier positive circuit as following:
   - G1, K1 and G2, K2 (for firing angle $\alpha = 0°$ to $180°$)
   - G3, K3 and G4, K4 (for firing angle $\alpha = 180°$ to $360°$)
3. Connect the two pulse controller unit 2 to the SCR in rectifier negative circuit as procedure No.2
4. Connect the voltage supply ± 15 V to two pulse controller and duty cycle phase controller
5. Interconnect the two pulse controller terminals between V_{st} and V_{var} in the same unit, and interconnect terminal V_{st} between the 2 units
6. Connect the power Supply 45 V to the synchronization voltage (V_{syn}) L-N for 2 units of two pulse controller, relatively
7. Adjust delay angle of unit 1 of two pulse controller at $\alpha = 90°$ and unit 2 of two pulse controller at $\alpha = 180°$
8. Connect the output terminal 1 of duty cycle phase controller to the terminal inhibit of two pulse controller unit 1
9. Connect the output terminal 2 of duty cycle phase controller to the terminal inhibit of two pulse controller unit 2
10. Interconnect the terminals of duty cycle phase controller between “D” and “0%”
11. Switch on the DC power supply and the Three Phase AC power supply.
12. Measure the oscilloscope of output voltage; V_O at resistor 300 Ω.
13. Change the delay angle of unit 2 as from 180 to 0 degree with an interval of 25 and record the experimental oscilloscope data into Experimental Table 25.1.1.
14. Reconnect the percentage terminals of duty cycle phase controller as 25%, 50%, 75% and 100% to measure the corresponding oscillogram relatively and record the waveform into the Experimental Table below.
15. Switch off the DC power supply and the Three Phase AC power supply.

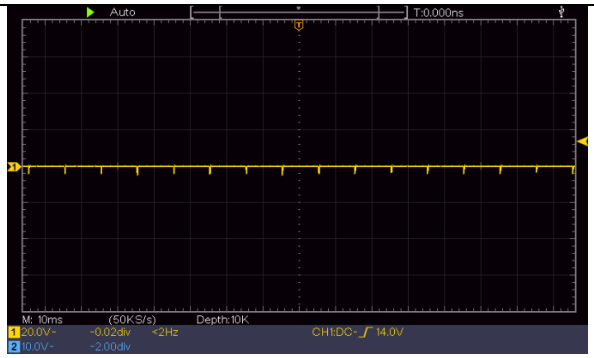
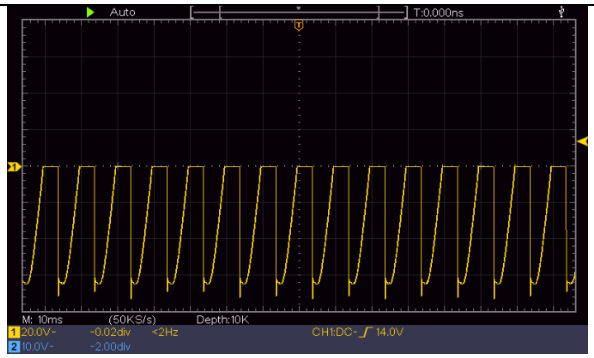
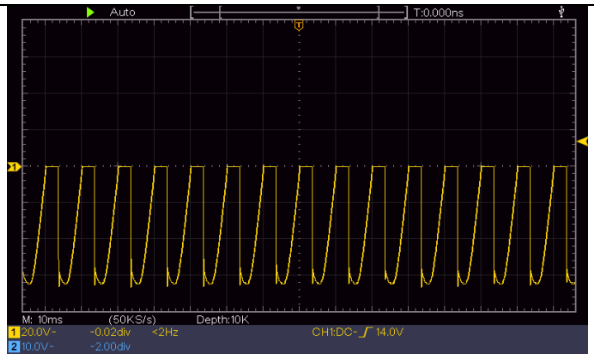
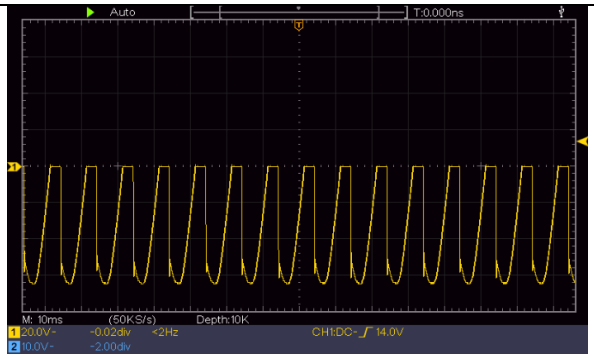
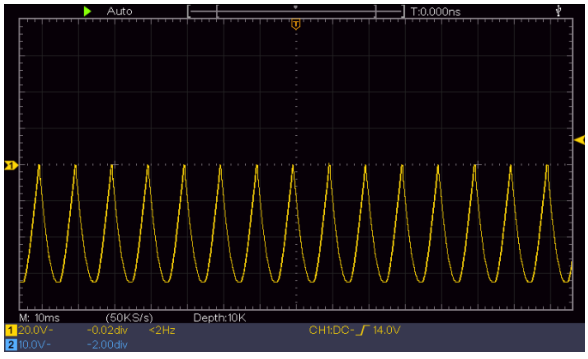
NOTE:

1. **Connect the circuit as shown in the wiring diagram above. Be cautious of the connections of the two pulse controller module as wrong connection may cause it to short circuit or burn.**
2. **Ensure the firing angle on both of the two pulse controller is set 180 degree (Maximum) and the output mode is set to pulse train.**

Experimental Table 25.1.1(D short with 0.00)

Setting	Waveform (Y1-Y2)
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

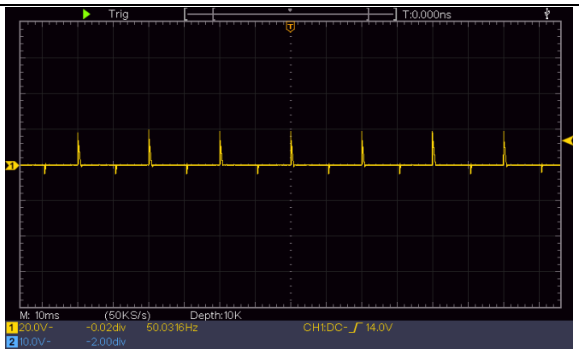
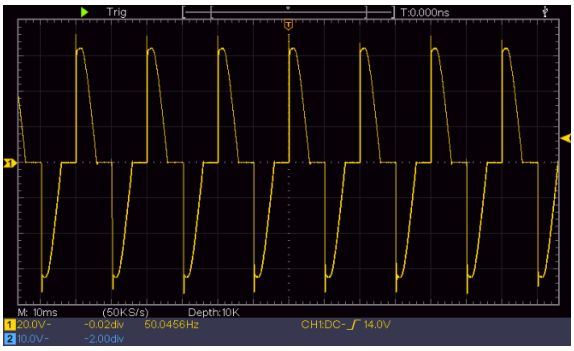
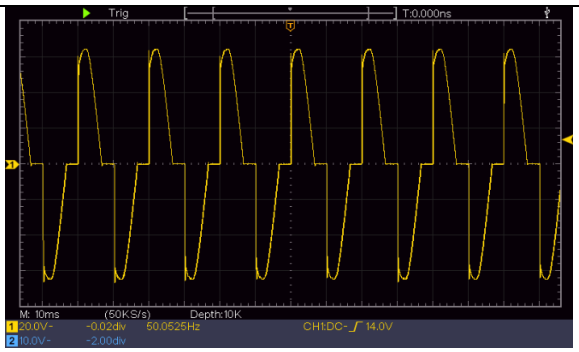
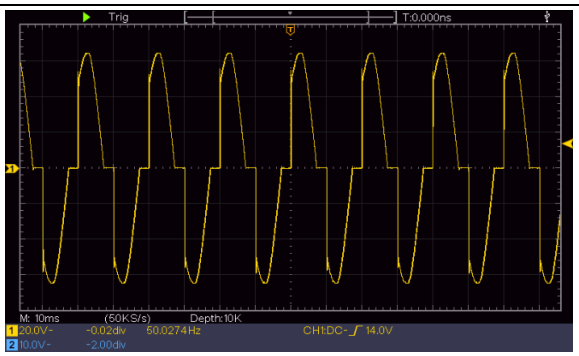
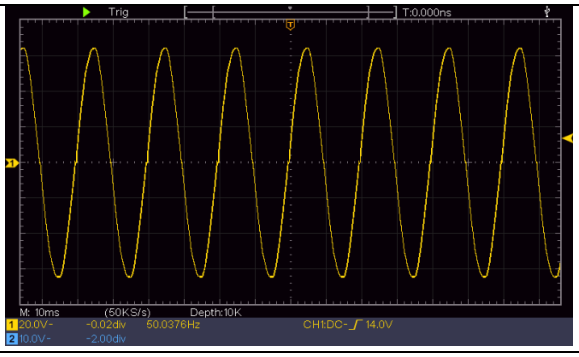
Expected Result Table 25.1.1 (D short with 0.00)

Setting	Waveform (Y1-Y2)
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Experimental Table 25.1.2 (D short with 0.25)

Setting	Waveform (Y1-Y2)
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

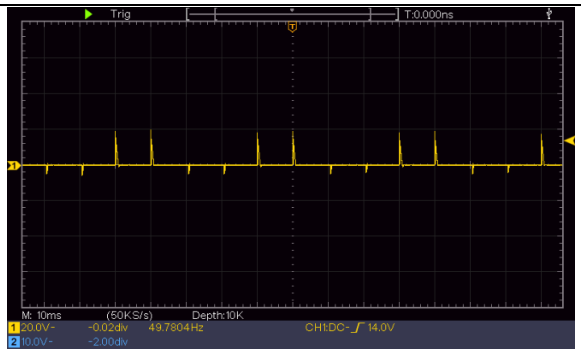
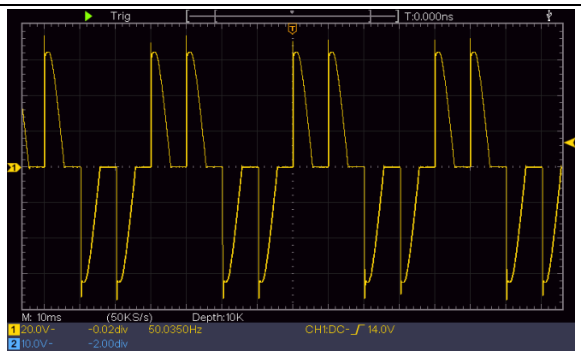
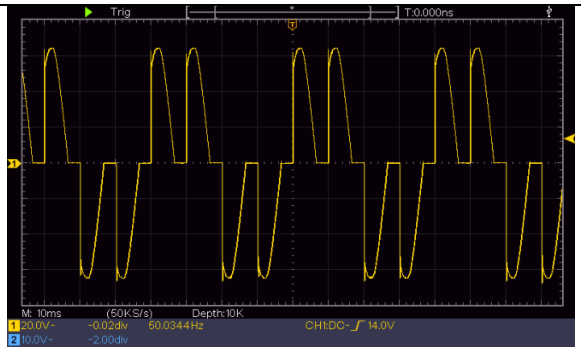
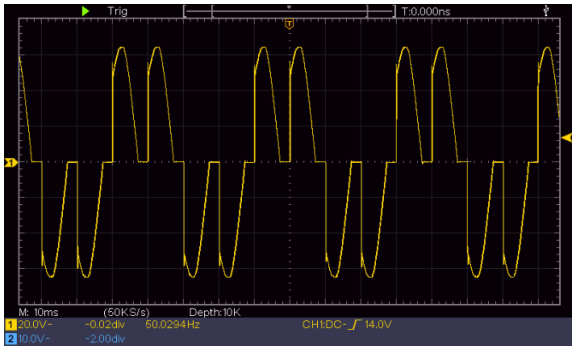
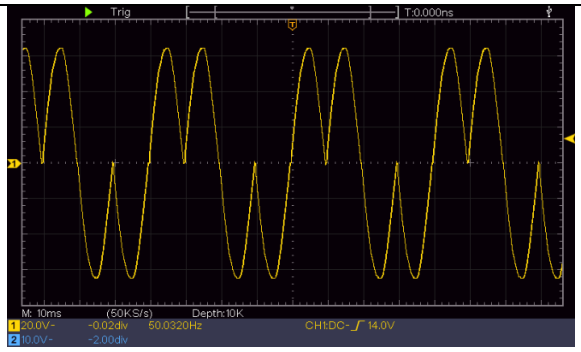
Expected Result Table 25.1.2 (D short with 0.25)

Setting	Waveform (Y1-Y2)
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.25 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Expected Result Table 25.1.2 (D short with 0.50)

Setting	Waveform (Y1-Y2)
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Expected Result Table 25.1.2 (D short with 0.50)

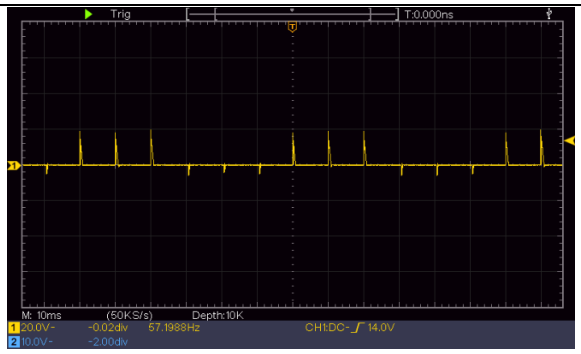
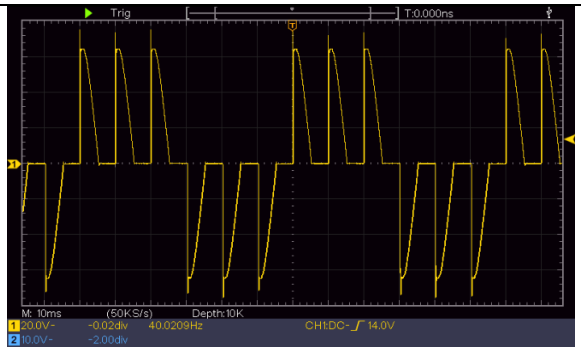
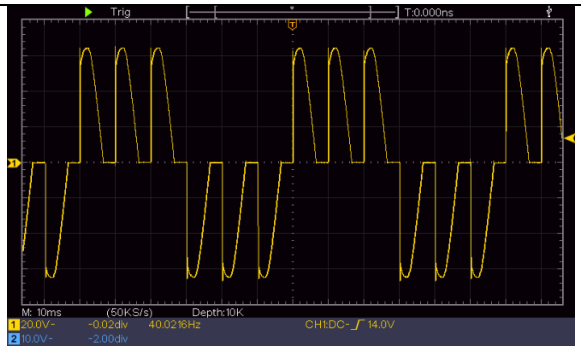
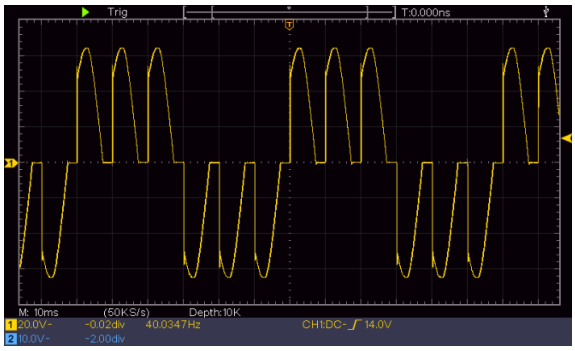
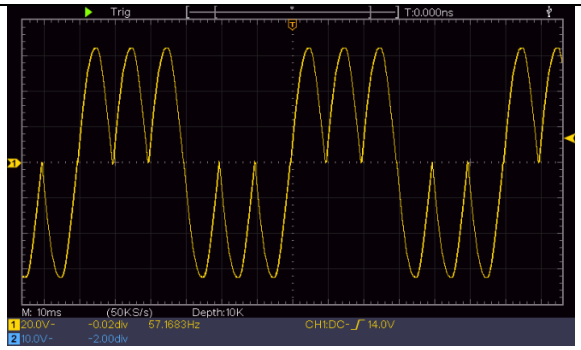
Setting	Waveform (Y1-Y2)
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.50 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Note the LED on both of the Two pulse Controller Module is blinking very fast

Expected Result Table 25.1.2 (D short with 0.75)

Setting	Waveform (Y1-Y2)
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Expected Result Table 25.1.2 (D short with 0.75)

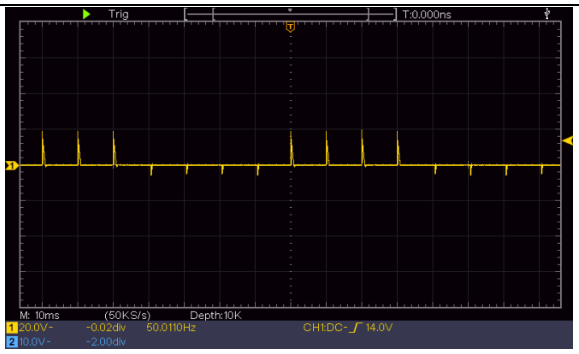
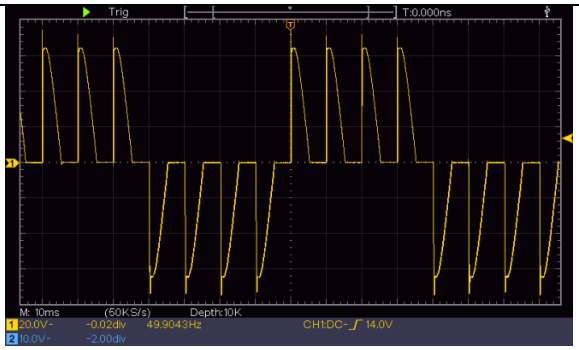
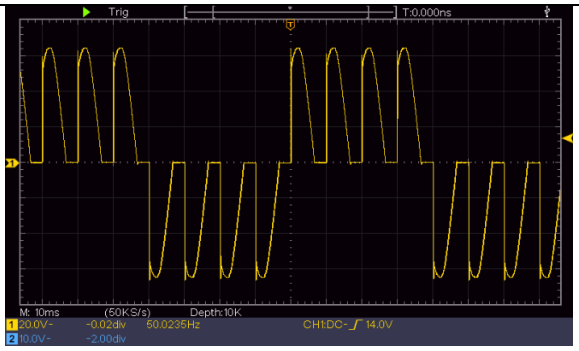
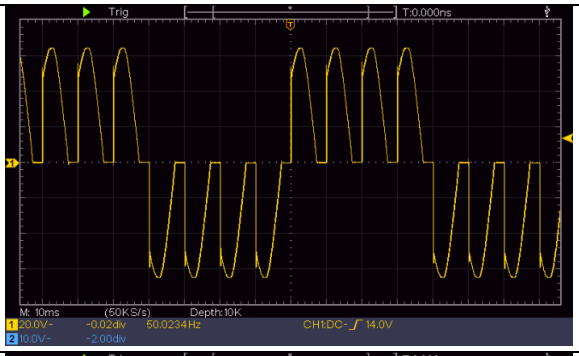
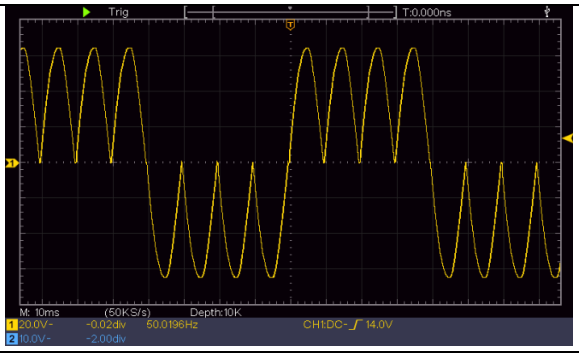
Setting	Waveform (Y1-Y2)
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 0.75 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Note the LED on both of the Two pulse Controller Module is blinking slower than in 0.50

Expected Result Table 25.1.2 (D short with 1.00)

Setting	Waveform (Y1-Y2)
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Expected Result Table 25.1.2 (D short with 1.00)

Setting	Waveform (Y1-Y2)
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 100 percent (maximum clockwise)	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 75 percent	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 50 percent	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 25 percent	
D short with 1.00 Unit 1 of the two pulse controller Firing angle VR at 50 percent. Unit 2 of the two pulse controller Firing angle VR at 0 percent (maximum counter clockwise)	

Note the LED on both of the Two pulse Controller Module is blinking slower than in 0.75

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The Seller warrants to the Purchaser that any equipment manufactured by it and bearing its name plate to be free from defects in material or workmanship, under proper and normal use and service, as follows: If, at any time within one (1) year from the date of shipment, the Purchaser notifies the Seller that in his opinion, the equipment is defective, and returns the equipment to the Seller's originating factory prepaid, and the Sellers inspection finds the equipment to be defective in material or workmanship **except part like switches, knob, push button, lighting, etc.** the Seller will promptly correct it by either, at its option, repairing any defective part or material or replacing it free of charge and return shipping lowest cost transportation prepaid by purchaser (if Purchaser requests premium transportation, Purchaser will be billed for difference in transportation costs). If inspection by the Seller does not disclose any defect in material or workmanship, the Seller's regular charges will apply. This warranty shall be effective only if use and maintenance is in accordance with Seller's instructions and written notice of a defect is given to the Seller within such period. **THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY OTHER WARRANTIES, WRITTEN, ORAL OR IMPLIED. SPECIFICALLY, WITHOUT LIMITATION, THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE**. The liability of the Seller shall be limited to the repair or replacement of materials or parts as above set forth.

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