EDULABS DIDACTIC

POWER ELECTRONICS TRAINER

EXPERIMENT 20

EXPERIMENTS MANUAL

Objectives: the trainee is able to

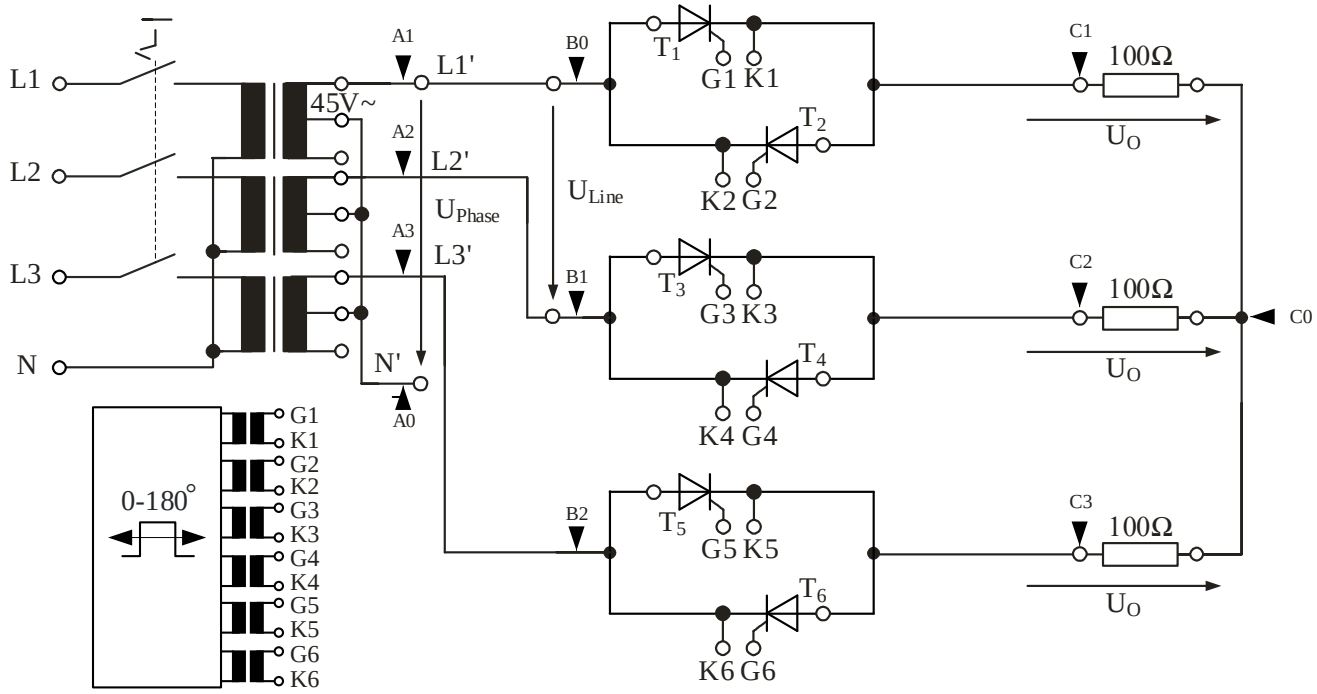
1. Determine the phase control characteristic of the star–connected three phase bidirectional connection on resistive load

Equipment designation

No.	Item	Model	Quantity
1	Group Of SCR Module	EM-21-01-05	1
2	Six Pulse Controller	EM-21-02-02	1
3	Resistive Load Module (I)	EM-21-03-01	1
4	Three Phase AC Power Supply	EM-21-04-01	1
5	DC Power Supply	EM-21-04-02	1
6	Group Of SCR Module	EM-21-01-05	1
7	19mm Shunt / Bridging Plug Set	EM-30-15-06	11
8	19mm Shunt / Bridging Plug Set (Stackable)	EM-30-15-08	1
9	2mm Stackable Test Lead Set (Banana Plug Type) (5 color coded)	EM-30-15-10	2
10	4mm Stackable Test Lead Set (Banana Plug Type)	EM-30-15-12	3
11	4mm Safety Stackable Connecting Lead	EM-30-15-01	1 set
12	Digital Storage Oscilloscope (Optional)	TDS-2102C	1

Procedure

1. Construct the circuit according to current diagram Figure. 20.1



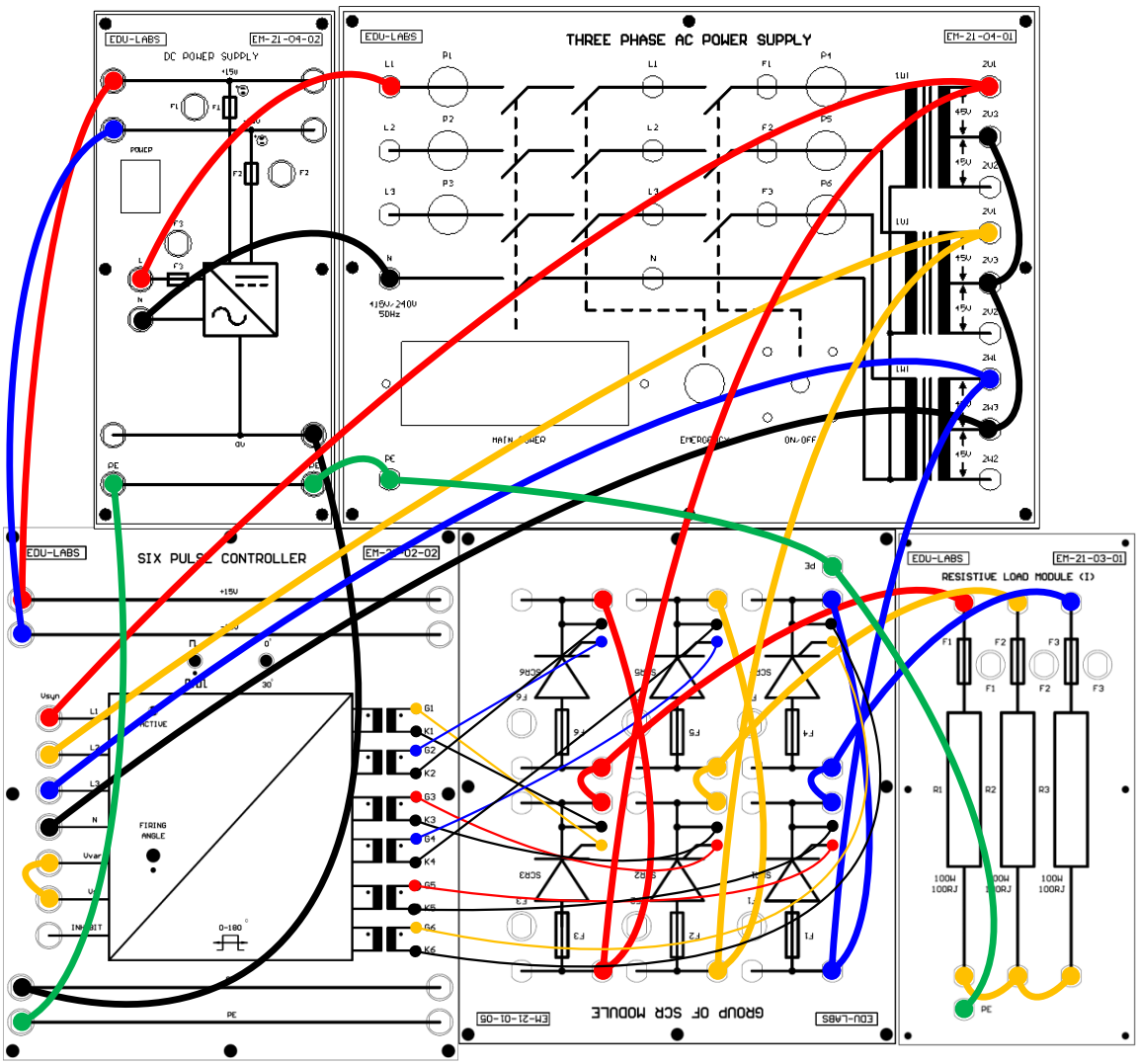


Figure 20.1 Current diagram for examine the phase control of the star–connected three phase bidirectional connection on resistive load

2. Connect the terminal of firing pulse transmitter to the corresponding gate and cathode terminal of SCR, relatively
   - G1, K1 to G1, K1 (to fire the pulse to the SCR on positive of phase L1')
   - G2, K2 to G2, K2 (to fire the pulse to the SCR on negative of phase L1')
   - G3, K3 to G3, K3 (to fire the pulse to the SCR on positive of phase L2')
   - G4, K4 to G4, K4 (to fire the pulse to the SCR on negative of phase L2')
   - G5, K5 to G5, K5 (to fire the pulse to the SCR on positive of phase L3')
   - G6, K6 to G6, K6 (to fire the pulse to the SCR on negative of phase L3')
3. Set the Six Pulse controller Module:
   - Pulse toggle: multi-pulse
   - Delay angle: 0º
   - Firing Angle VR: 0 percent(maximum counterclockwise)
4. Connect the AC power supply 45 V to the synchronization voltage (V_{syn}) of the firing pulse transmitter, relatively
   - supply terminal; L1' to the synchronization voltage terminal; L1'

- supply terminal; L2' to the synchronization voltage terminal; L2'
- supply terminal; L3' to the synchronization voltage terminal; L3'
- supply terminal; N' to the synchronization voltage terminal; N'

5. Connect the voltage supply $\pm 15\,V$ to firing pulse transmitter
6. Interconnect the firing pulse transmitter terminal between V_{st} and $V_{set.}$
7. Switch on both Three Phase AC power supply and DC power supply.

Oscilloscope probe connection Procedure

Refer to Figure 20.1 while connecting.

Since all oscilloscope channels have common ground (GND), therefore:

1. To capture the phase voltage waveforms U_{phase} connect (A1 – A0) to CH1, (A2 – A0) to CH2, and (A3 – A0) to CH3. Record the waveform into **Experimental Table 20.1.1**. Remove the connection after capturing the waveforms.

Note: Line voltage waveforms U_{line} cannot be capture together as they do not share the same reference point. Shot circuit will occur if they were connected to the oscilloscope together.

2. To capture the line voltage L1 connect (B0 – B1) to CH1. Record the waveform into **Experimental Table 20.1.2**. Remove the connection after capturing the waveforms.
3. To capture the line voltage L2 connect (B1 – B2) to CH2. Record the waveform into **Experimental Table 20.1.2**. Remove the connection after capturing the waveforms.
4. To capture the line voltage L3 connect (B0 – B2) to CH3. Record the waveform into **Experimental Table 20.1.2**. Remove the connection after capturing the waveforms.
5. To capture the output waveforms U_o connect (C1 – C0) to CH1, (C2 – C0) to CH2, and (C3 – C0) to CH3. Record the waveform into **Experimental Table 20.1.3**.

IMPORTANT!!!

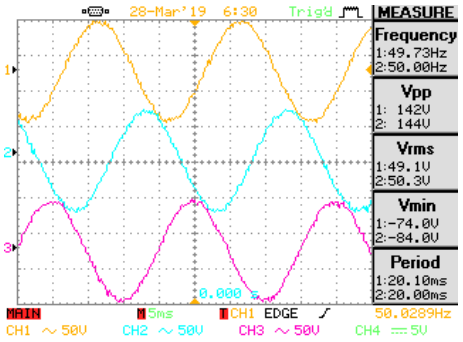
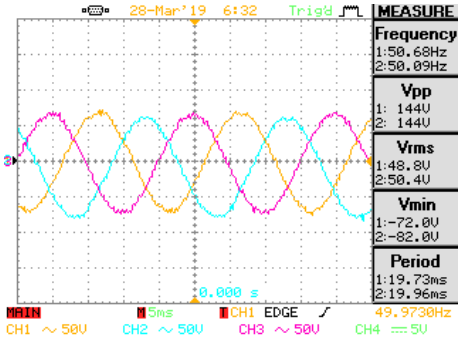
Negligence of the Oscilloscope procedure will cause damage to the oscilloscope and the modules due to short circuit.

8. Capture the waveform Uo with different firing angle as in **Experimental Table 20.1.3**.
9. Switch of the power supplies.

Experimental Table 20.1.1

Description	Waveform U_{phase}

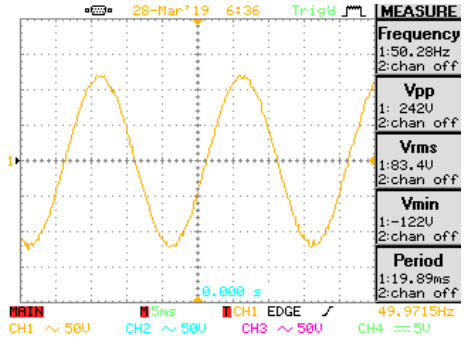
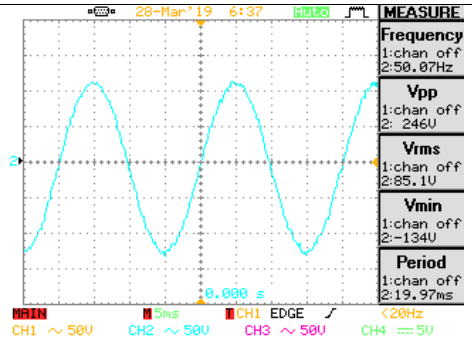
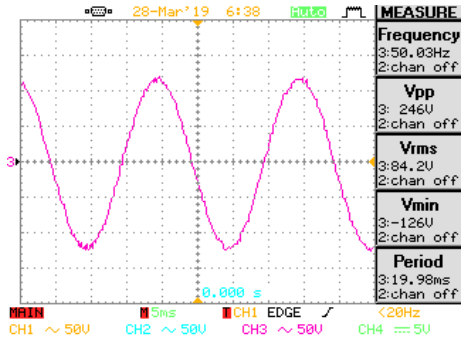
Expected Result Table 20.1.1

Description	Waveform U_{phase}
Separate waveform CH1(Yellow) = phase 1 CH2 (Blue)= phase 2 CH3 (Violet)= phase 3	 **Phase shift in between each phase 120° phase angle**
Merged waveform CH1(Yellow) = phase 1 CH2 (Blue)= phase 2 CH3 (Violet)= phase 3	

Experimental Table 20.1.2

Description	Waveform U_{line}

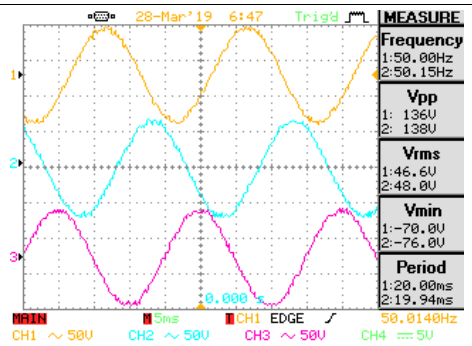
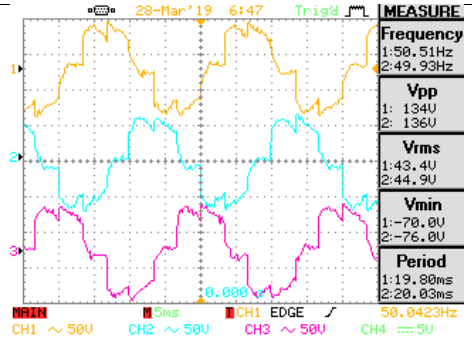
Expected Result Table 20.1.2

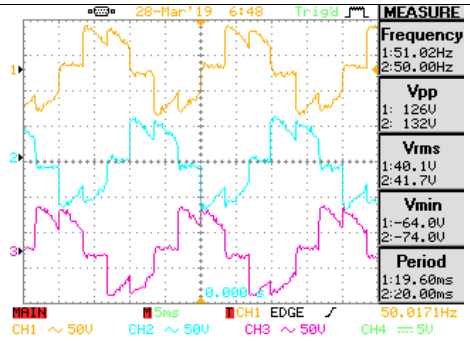
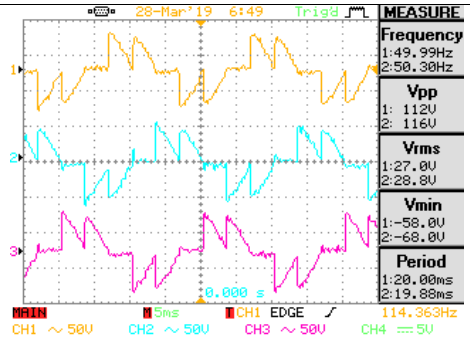
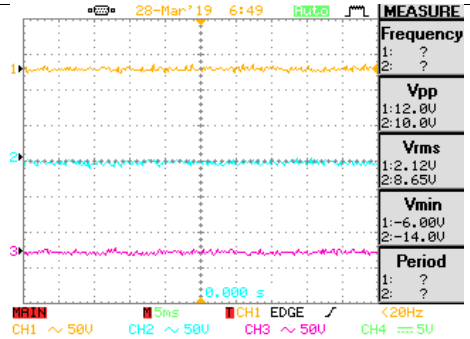
Description	Waveform U_{line}
Line voltage, L1 (B0 - B1)	
Line voltage, L2 (B1 - B2)	
Line voltage, L3 (B0 - B2)	

Experimental Table 20.1.3

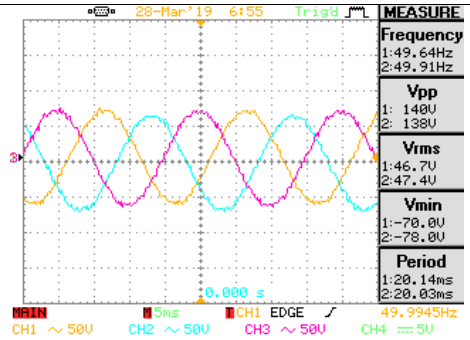
Firing angle VR	Waveform U_o

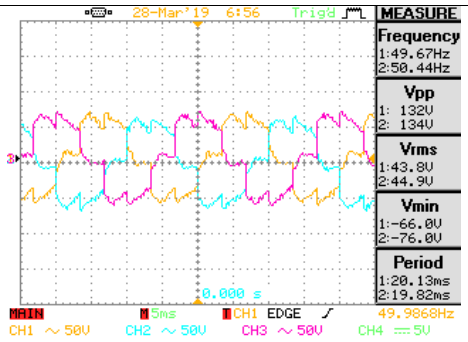
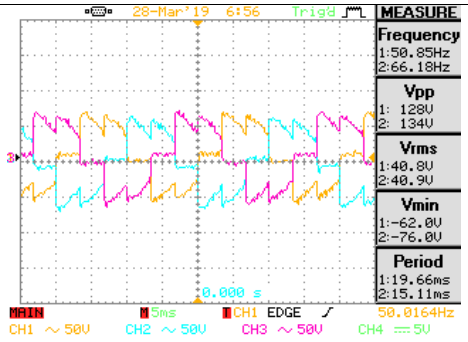
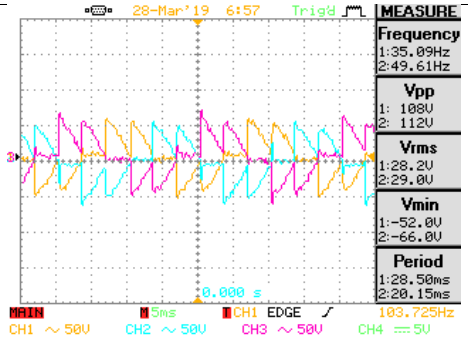
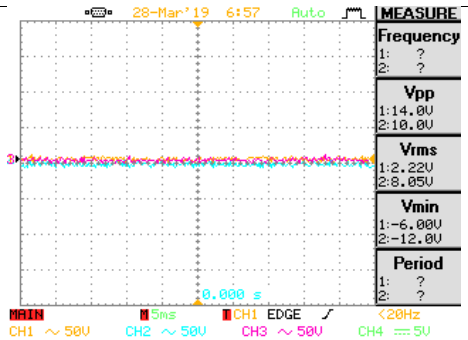
Expected Result Table 20.1.3

Firing angle VR	Waveform U_o
0º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)
45º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)

90º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)
135º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)
180º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)

Experimental Table 20.1-3 (Merged)

Firing angle VR	Waveform U o
0º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)

45º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)
90º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)
135º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)
180º	 CH1= (C1 – C0) CH2= (C2 – C0) CH3= (C3 – C0)

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