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TOPIC	: INVERTERS

inverters

Introduction

1. An inverter is a device that changes or inverts direct current (DC) input to alternating current (AC) output.
2. It doesn't "create" or "make" electricity, just changes it from one form to another. DC in is changed to AC out.
3. Output is usually 120 or 240 volts at 50-cycle alternating current to match line power.

- **Inverters are used in PV systems to convert direct current (DC) power from batteries or PV arrays into alternating current (AC) power.**

- **Other inverter applications include:**
  - Fuel cells
  - Wind turbines and microturbines
  - Variable-frequency drives
  - Uninterruptible power supplies
  - Electronic ballasts and induction heaters
  - HVDC power transmission

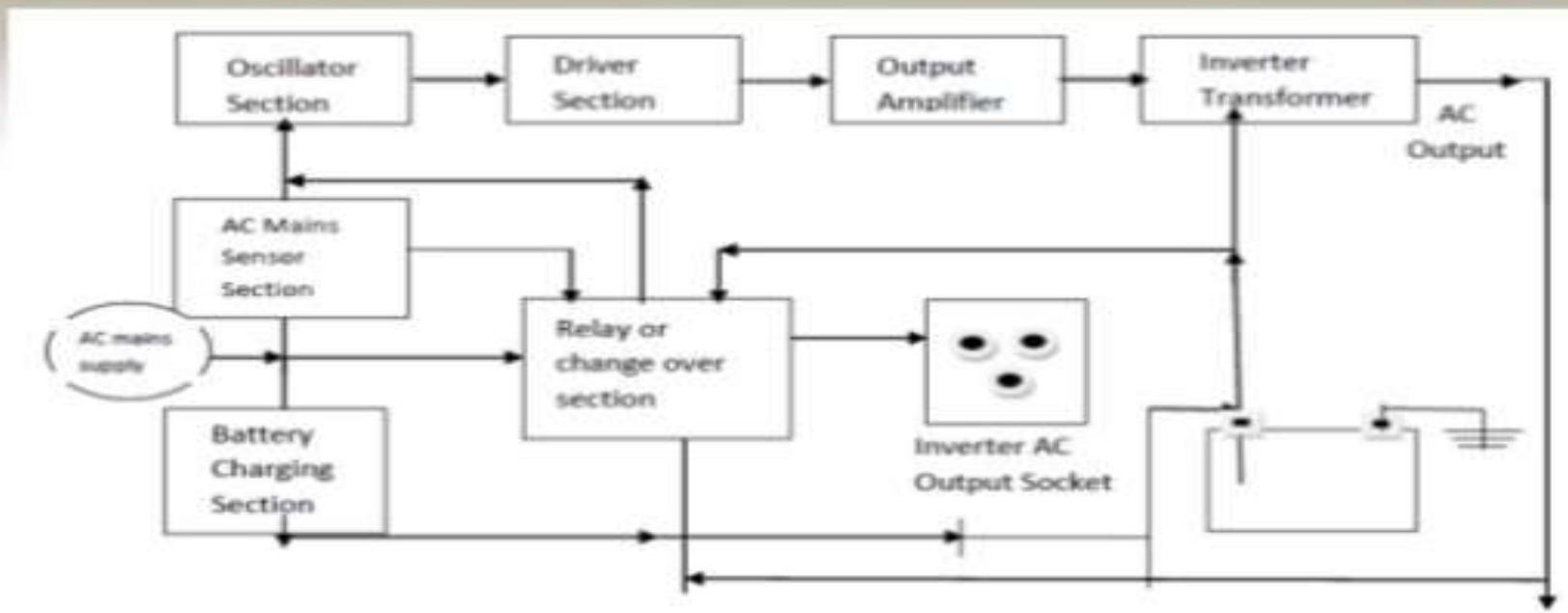
Direct-Current (DC)

- **Direct current (DC) is a unidirectional flow of electrical charge that does not vary in polarity between positive and negative values over time.**
- **Solar cells and batteries are examples of DC devices.**
  - Most electronic circuits also operate on DC power.
- **DC circuits are defined by a positive and negative polarity, or poles. Electrons flow in one direction.**

Alternating Current (AC)

- Alternating current (AC) is an oscillating flow of electrical charge that periodically changes direction over time.
- In an AC circuit, the two poles alternate between negative and positive, continually reversing direction of the electron flow.
- The changing polarity of AC over time is what distinguishes it from DC.

Block Diagram of an inverter

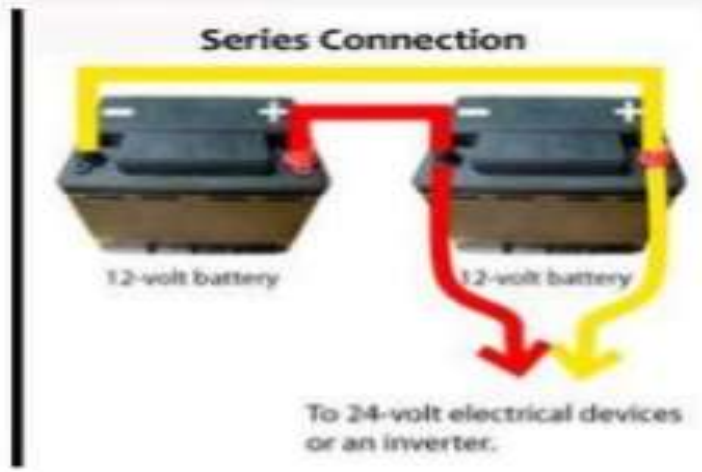


BATTERIES

- The runtime of an inverter is dependent on the battery power and the amount of power being drawn from the inverter at a given time.
- When attempting to add more batteries to an inverter, there are two basic options for installation:
    A. Series configuration
    B. Parallel Configuration

Series configuration

If the goal is to increase the overall voltage of the inverter, one can daisy chain batteries in a series configuration. In a series configuration, if a single battery dies, the other batteries will not be able to power the load.



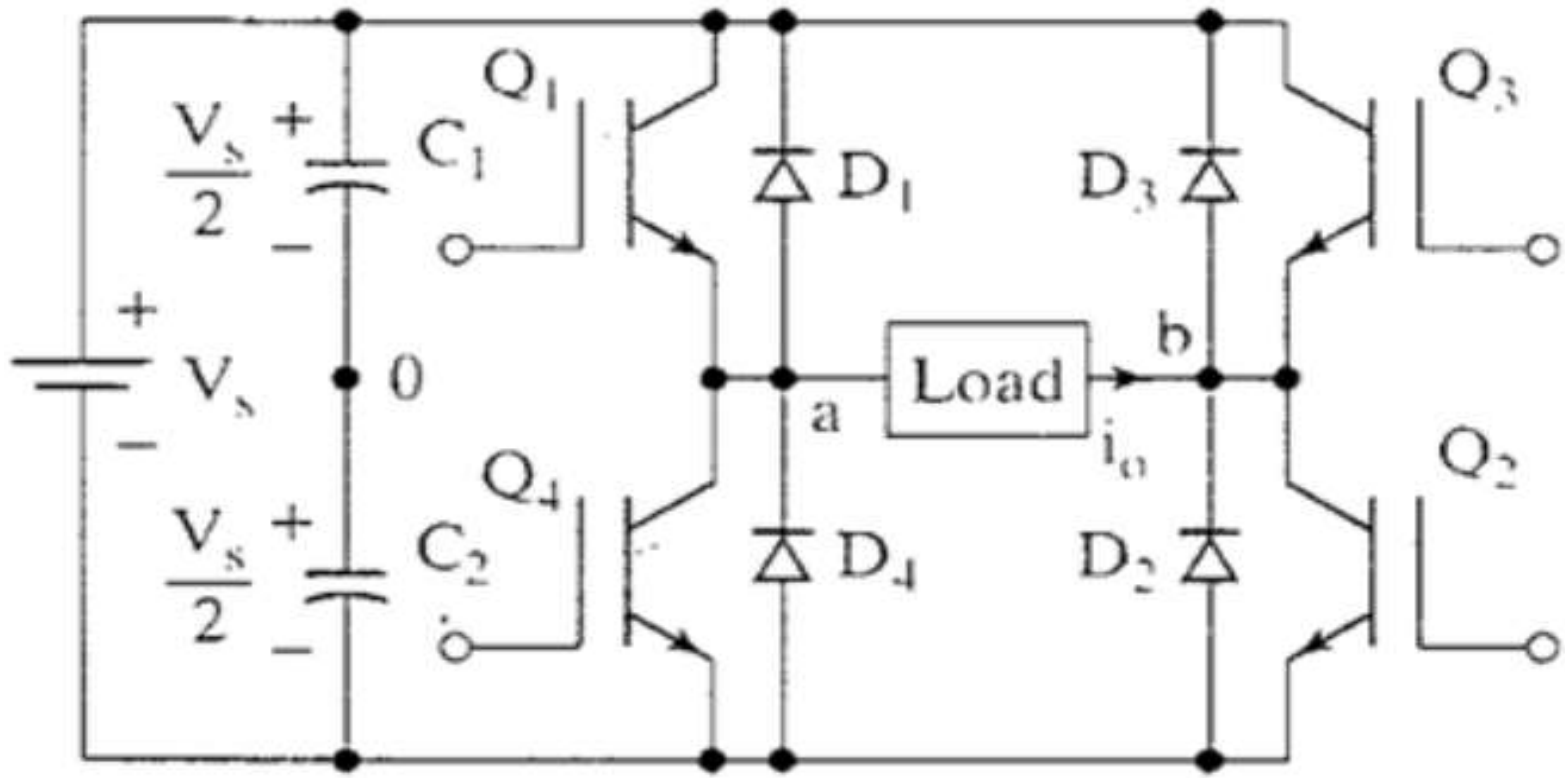
Parallel Configuration

If the goal is to increase capacity and prolong the runtime of the inverter, batteries can be connected in parallel. This increases the overall ampere-hour (Ah) rating of the battery set.

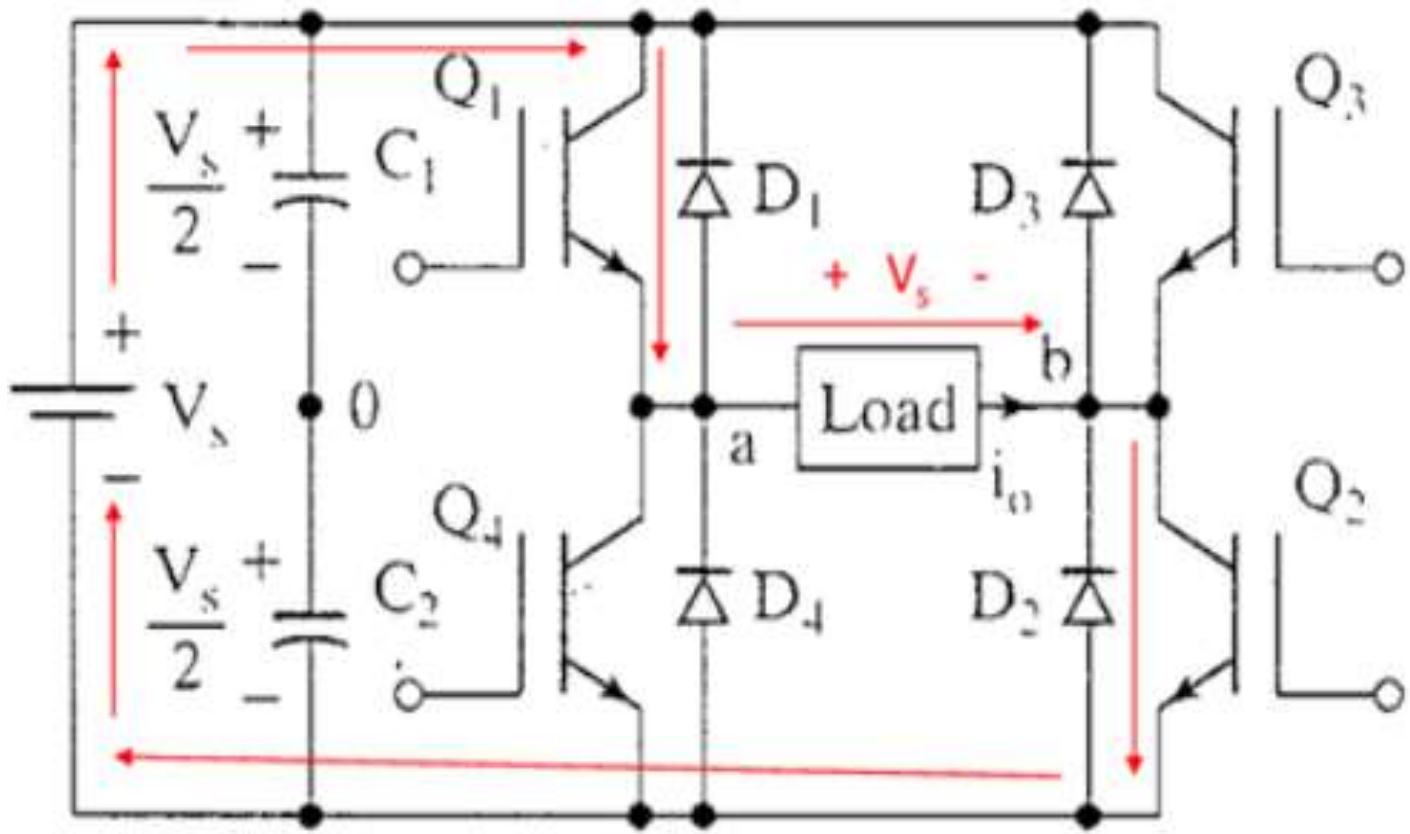
If a single battery is discharged though, the other batteries will then discharge through it. This can lead to rapid discharge of the entire pack, or even an over-current and possible fire. To avoid this, large paralleled batteries may be connected via diodes or intelligent monitoring with automatic switching to isolate an under-voltage battery from the others.

Single Phase Full Bridge Inverter

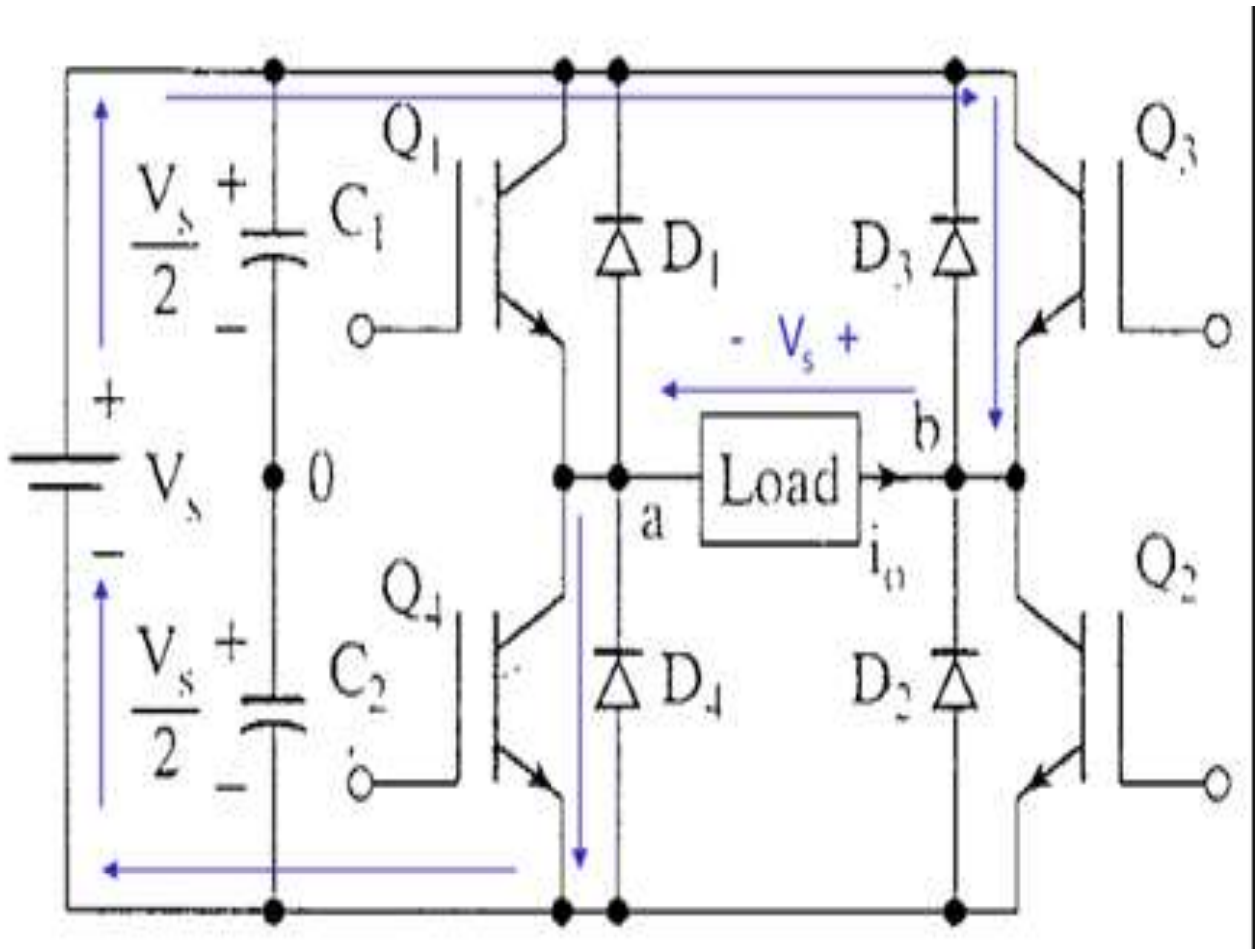
- A single phase bridge DC-AC inverter is shown in Figure below. The analysis of the single phase DC-AC inverters is done taking into account following assumptions and conventions.
  1) The current entering node a in Figure 8 is considered to be positive.
  2) The switches S1, S2, S3 and S4 are unidirectional, i.e. they conduct current in one direction.


Q1
Q3
Vs/2 +
C1
D1
D3
–
+
Vs
0
b
Load
a
io
Q4
Q2
Vs/2 +
C2
D4
D2
–

- When the switches S1 and S2 are turned on simultaneously for a duration $0 \leq t \leq T1$, the the input voltage Vin appears across the load and the current flows from point a to b.
- Q1 – Q2 ON, Q3 – Q4 OFF ==> $v_o = V_s$
-


Q1
Q3
Vs/2
+
C1
–
D1
D3
+ Vs -
+
Vs
–
0
a
Load
b
io
Q4
Q2
Vs/2
+
C2
–
D4
D2

- If the switches S3 and S4 turned on duration $T1 \leq t \leq T2$, the voltage across the load the load is reversed and the current through the load flows from point b to a.
  Q1 – Q2 OFF, Q3 – Q4 ON ==> v o = -Vs


Q1
Q3
Vs/2 +
C1
D1
D3
- Vs +
+
Vs
0
a
Load
b
io
Q4
Q2
Vs/2 +
C2
D4
D2

applications

- **Use in fuel cells and UPS**
- **use in Solar Panels**