

TYPES OF DC LINKS

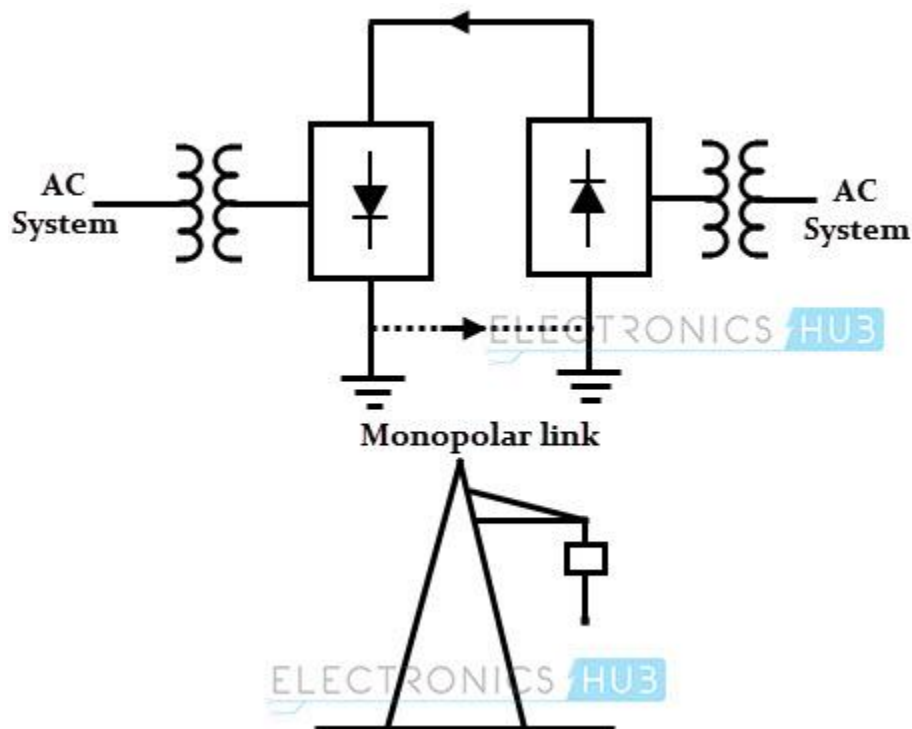
The high voltage dc links may be classified into:

1. Monopolar Link
2. Bipolar Link
3. Homopolar Link.

Monopolar DC Link

Monopolar link has only one conductor and return path is provided by permanent earth or sea. The line usually operates with negative polarity with respect to ground so as to reduce corona loss and radio interference.

The earth electrodes are designed for continuous rated current operation and for any overload capacity required in the specific case. The sea or ground return is permanent and of continuous rating. The ground return path has a low resistance and, therefore, low power loss in comparison with a metallic line conductor of economical size and equal length provided the ground electrodes are of proper design. Monopolar line is more economical than a bipolar line because the ground return saves the cost of the one metallic conductor and losses in it.



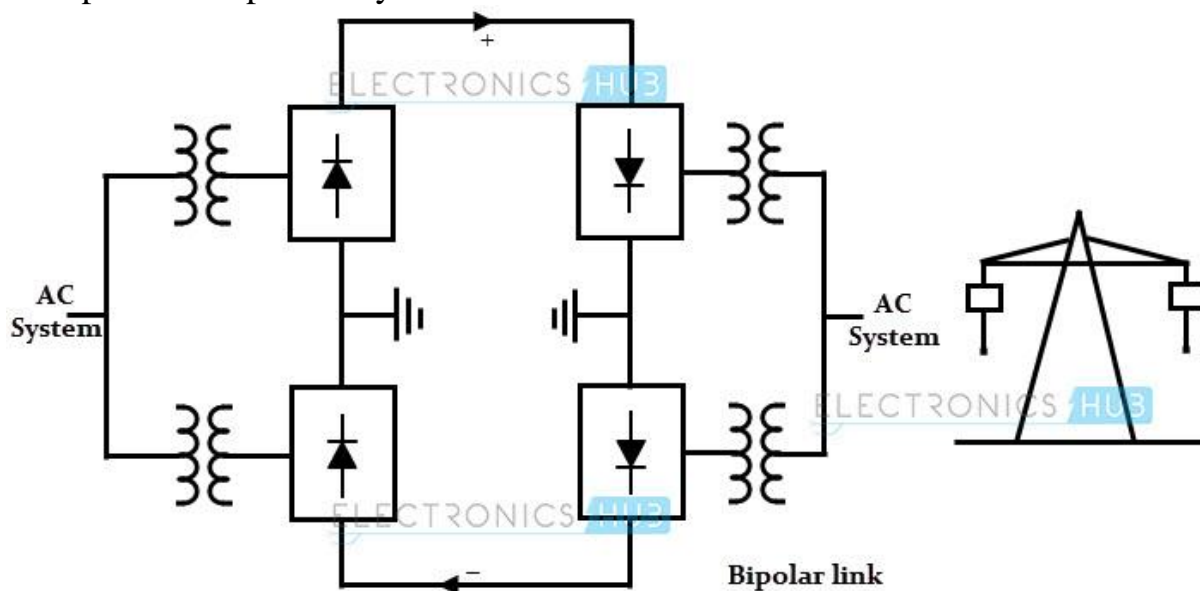
Monopolar HVDC links were used only for low power rating and mainly for cable transmission. In some cases the monopolar lines installed earlier are converted into bipolar systems by adding additional substation pole and transmission pole.

Monopolar HVDC line has only the rating equal to half of corresponding bipolar line rating and is; therefore, not economically competitive with EHV ac schemes for submarine cables longer than 25 km and of power rating of about 250 MW. For such cable transmission high voltage ac scheme is not technically feasible due to large charging currents with ac cables beyond thermal limit. Bipolar cable is not justified for ratings up to about 500 MW. Recent HVDC cable schemes are bipolar.

Bipolar DC Link

This is most widely used dc link for overhead long distance HVDC transmission systems and also for back-to-back HVDC system. This link has two conductors—one operating with positive polarity and the other with negative polarity with respect to the earthed tower structure.

There are two converters of equal voltage rating and connected in series at each end of the dc line. The neutral points, i.e., the junction between converters may be grounded at one end or at both the ends. If it is grounded at both ends each pole can operate independently.



The rated voltage of a bipolar link is expressed as ± 500 V. Power rating of one pole is about half of bipolar power rating. The earth carries only a small out-of-balance current during the normal operation. When the currents in the two conductors are equal, the ground current is zero.

During fault or trouble on one of the lines, the other line along with ground return can supply half of the rated load. Thus continuity of supply is maintained. After

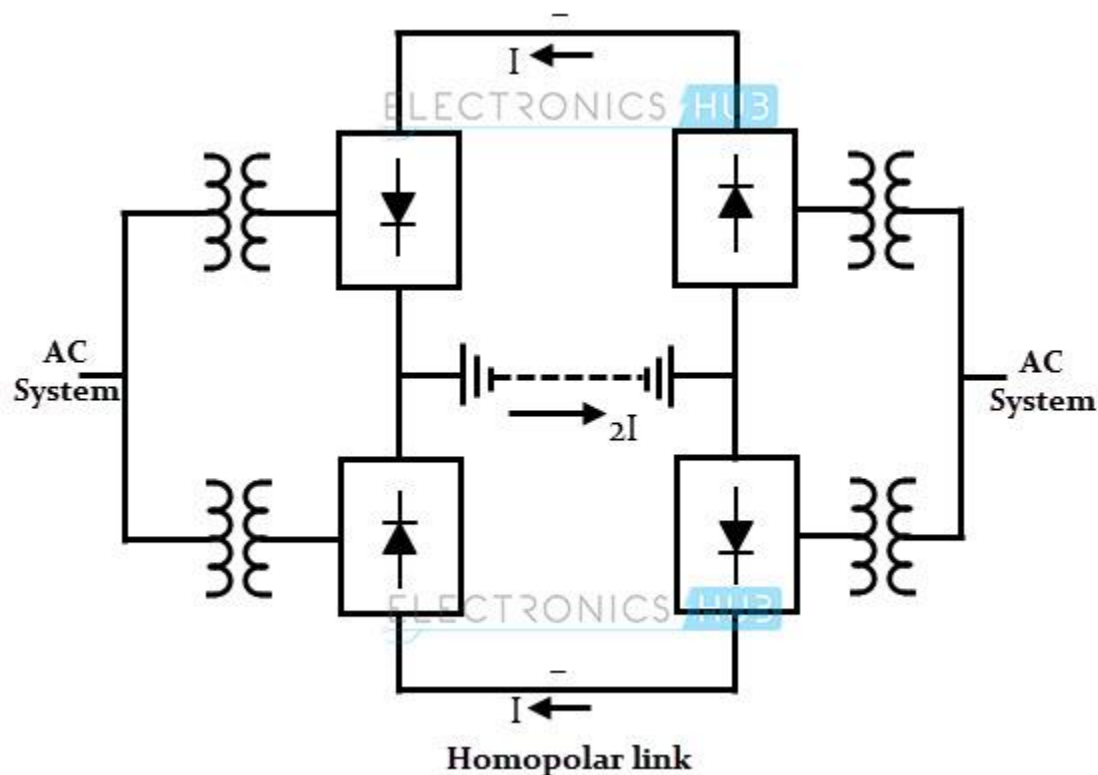
taking corrective measures, the system is switched over to normal bipolar operation. Thus the reliability of a bipolar line is equal to that of a double circuit 3-phase line although it has only two conductors instead of 6 for 3-phase line.

Example of bipolar HVDC link is Ranchi-Delhi single bipolar overhead line of length 810 km, capacity 1,500 MW and operating at ± 500 kV for transmission of bulk power. This line is designed to operate in bipolar mode under normal conditions, both the poles sharing the load equally with negligible current (less than 10 A) in the ground return path.

In case of fault on one of the poles, the system automatically switches over to monopolar ground return mode supplying 50% of the rated load. Thereafter the system may be changed over to bipolar metallic return mode when the other conductor is used as return conductor.

Homopolar DC Link

A homopolar link has two or more conductors having the same polarity, usually negative, and always operates with ground as the return conductor. In case of a fault on any one of the conductors, the converter equipment can be reconnected so that the healthy conductor can supply power. Such a scheme is very complicated and is preferred to a bipolar link provided continuous ground return does not pose additional problems.



Such a scheme may be used for the following:

Two homopolar overhead lines supplying to a common monopolar cable termination.

One overhead transmission tower carrying insulator strings supporting two homopolar transmission line conductors.

Thus homopolar dc link has limited applications.