## Diode Clipping Circuits

Basic Definition:

There is a variety of diode circuits called ***clippers*** (***limiters***) that have the ability to "clip" off a portion of the input signal above (***positive***) or below (***negative***) certain level without distorting the remaining part of the alternating waveform. Depending on the orientation of the diode, the positive or negative region of the input signal is "clipped" off.

There are two general categories of clippers: ***series*** and ***parallel***. The series configuration is dined as one where the diode is in series with the load. While the parallel variety has the diode in a branch parallel to the load (see Fig. -1).

*vi D*

*V*



*vi*





*R vo*



*T*

*vo*

*T/2 T*

*0 T/2 t 0 t*

* + *V*  *V*

Simple Series Clipper

*vi R vo*

*V*



|  |  |  |
| --- | --- | --- |
| *V* |  |  |
| *0* | *T/2 T* |

*0 T/2*

 *V*



*T vi*

*t*





*D vo*

*t*



Simple Parallel Clipper

**Fig. -1**

## Example -1:

Biased Series Clipper, see Fig. -2.

*E D*

*5.2V*

*Si*

*R*

*vi*

*9*

*0*

*T/2*

*T*

*- 9*

*vi vo*

*t*



*vi vo*

*Vi*

*13.5*

*4.5*

*T/2*

*t1*

*t2*

*T*

*0*

*- 4.5*

*vo*

*13.5*

*4.5*

*0*

*E*  *VT*

*4.5V*

*Vi*

*D*

*Ideal*

*R*

For *t* = 0 → *t1* and *t2* → *T*; D ON,

and *vo* = *vi* + 4.5 V. *t*

For *t* = *t1* → *t2*; D OFF,

and *vo* = 0 V.

*vi t*

*vo*

*13.5*

*4.5*

*- 9*

*- 4.5*

*0*

*9*

**Fig. -2 (cont.)**

A variety of series and parallel clippers with the resulting output for the sinusoidal input are provided in Fig. -3.

**Fig. 3**

## Example -2:

Double Diode Series Clipper, see Fig. -4.

*3.3V*

*E2*

*Si*

*D2*

*Ge*

*R*

*7.7V*

|  |  |
| --- | --- |
| *12* |  |
| *0**-12* | *T/2 T* |

*vi*

*E1 D1*

*vi vo*

*t*

*E*  *V V*

*D1*

1 *T*1 *i1*

*4V*

*E*  *V V*

*Ideal*

*D2*

2 *T*2 *i2*

*R*

*8V*

*Ideal*

**Fig. -4**

 *vi vo*

For *t* = 0 → *t1*, *t2* → *t3*, and *t4* → *T*; both D1 and D2 will be OFF,

*vi*

*V*

*20*

*i2*

*8*

*T/2*

*T*

*t1 t2 t3 t4*

*- 4 0*

*- 16*

*vo*

*Vi*

*1*

*8*

*- 40*

and *vo* = 0 V.

For *t* = *t1* → *t2*; D1 ON while D2 OFF,

and *vo* = *Vi* = *vi* – 4 V.

*1*

For *t* = *t3* → *t4*; D1 OFF while D2 ON, *t*

and *vo* = *Vi* = *vi* + 8 V.

*2*

*vi*

*vo*

*8*

*- 12 - 8*

*0*

*4*

*12*

*- 4*

*t*

 **Fig. -4 (cont.)**

## Example -3:

Biased Parallel Clipper, see Fig. -5.

*R*

*vi*

*10*

*0*

*T/2*

*T*

*- 10*

*v*

*i vo*

1. *Si*
2. *5.7V*

*t*

Fig. -5

 *R*

*v*

 *o vi*

* *id*  *0*

*Vtransition*

* *E*

*10*

*5V*

*Vtransition* – *id R* – *Vd* + *E* = 0;

*Vtransition* = 0.7 – 5.7 = – 5 V.

For *t* = 0 → *t1* and *t2* → *T*; D ON, and *vo* = – 5 V.

For *t* = *t1* → *t2*; D OFF, and *vo* = *vi*.

*vo*

*- 10 - 5*

*10*

*0*

*- 5*

*- 10*

*vi*

*0*

*-5*

*- 10*

*vo*

*0*

*-5*

*T/2*

*t1 t2*

*T*

*t*

*Vtransition*

*t*

*- 10*

##  Fig. -5 (cont.)

##

A variety of parallel clippers with the resulting output for the sinusoidal input are provided in Fig. -6.



Fig. -6

## Example -4:

Double Diode Parallel Clipper, see Fig. -7.

*vi*

*9*

*T*

*0*

*T/2*

*- 9*

*R*

*vi vo*

*D*1

*E*1

*Si*

*D*2

2.3*V E*2

*Si*

5.3*V*

*t*

 *R R*

*v*

 *o vo*

*d*



*Vtr*

1



*i* 1  0*D*1

*E*1

*d*

*Si*

2.3*V*



*Vtr*

2



*i* 2  0*D*2

*E*2

*Si*

5.3*V*

*Vtr* – *id*

*R* – *Vd* – *E1* = 0;

*Vtr*

+ *id*

*R* + *Vd* + *E2* = 0;

1 1 2 2

2

*Vtr* = 0.7 + 2.3 = 3 V.

1

*Vtr*

= – 0.7 – 5.3 = – 6 V.

**Fig. -7**

For *t* = 0 → *t1*, *t2* → *t3*, and *t4* → *T*; both D1 and D2 will be OFF,

*vi*

*9*

*3*

*t*

*1*

*t t*

*2 3*

*t T*

*4*

*Vtr*1

*0*

*T/2*

*- 6*

*- 9*

*Vtr*

2

*vo*

*3*

*0*

*- 6*

and *vo* = *vi*.

For *t* = *t1* → *t2*; D1 ON while D2 OFF,

and *vo* = 3 V. *t*

For *t* = *t3* → *t4*; D1 OFF while D2 ON,

and *vo* = – 6 V.

*vi t*

*vo*

*- 9 - 6*

*3*

*0 3*

*- 6*

*9*

**Fig. -7 (cont.)**