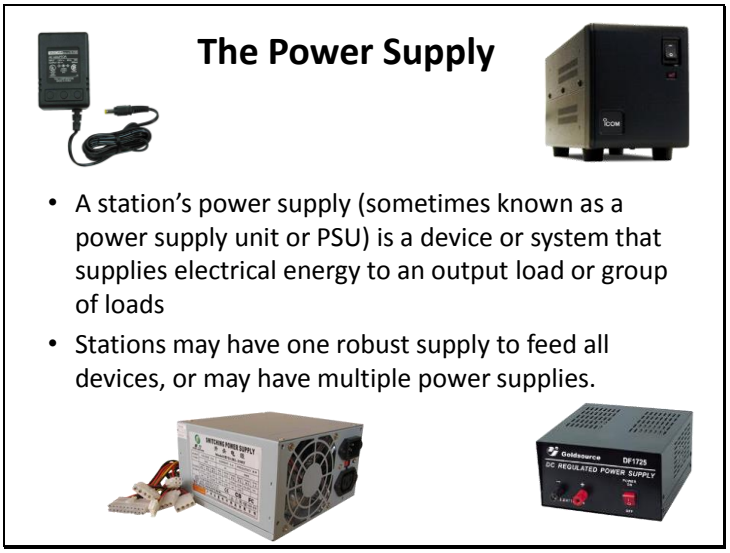
Slide 1

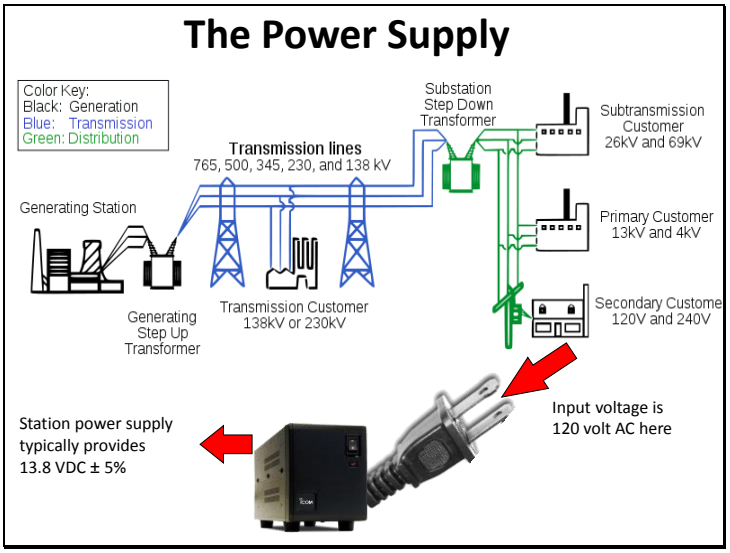
CHAPTER 10

Power Supplies

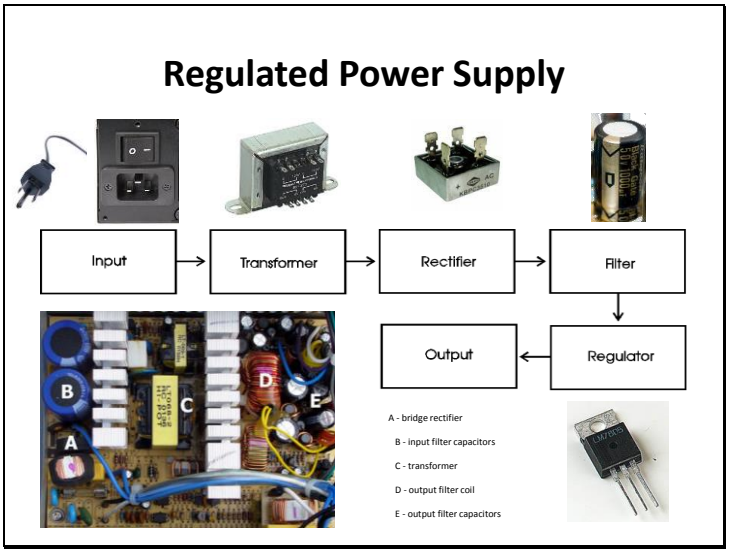
Slide 2


The Power Supply
A station's power supply (sometimes known as a power supply unit or PSU) is a device or system that supplies electrical energy to an output load or group of loads
Stations may have one robust supply to feed all devices, or may have multiple power supplies.
Goldsource
DF1725
DC REGULATED POWER SUPPLY

Slide 3


The Power Supply
Color Key:
Black: Generation
Blue: Transmission
Green: Distribution
Substation
Step Down
Transformer
Subtransmission
Customer
26kV and 69kV
Transmission lines
765, 500, 345, 230, and 138 kV
Generating Station
Primary Customer
13kV and 4kV
Generating
Step Up
Transformer
Transmission Customer
138kV or 230kV
Secondary Custome
120V and 240V
Input voltage is
120 volt AC here
Station power supply
typically provides
13.8 VDC ± 5%

Slide 4


Regulated Power Supply
Input
Transformer
Rectifier
Filter
Regulator
Output
A
B
C
D
E
A - bridge rectifier
B - input filter capacitors
C - transformer
D - output filter coil
E - output filter capacitors

Slide 5

Transformer

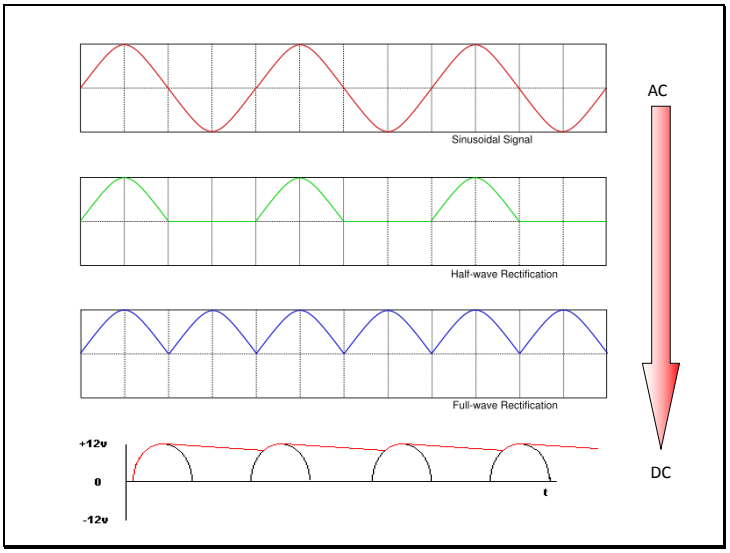
- A transformer is a device that <u>transfers electrical energy from one circuit to another through a shared magnetic field</u>
- A changing current in the first circuit (the primary) creates a changing magnetic field
- In turn, this magnetic field induces a changing voltage in the second circuit (the secondary)
- By adding a load to the secondary circuit, one can make current flow in the transformer, thus transferring energy from one circuit to the other

Slide 6

Rectifier

- A rectifier is an electrical device that **converts alternating current to direct current**, a process known as “rectification”
- Rectifiers are used as components of power supplies and as detectors of radio signals
- Rectifiers may be made of solid state diodes, vacuum tube diodes, mercury arc valves, or other components
- A circuit which performs the opposite function (converting DC to AC) is known as an “inverter”

Slide 7

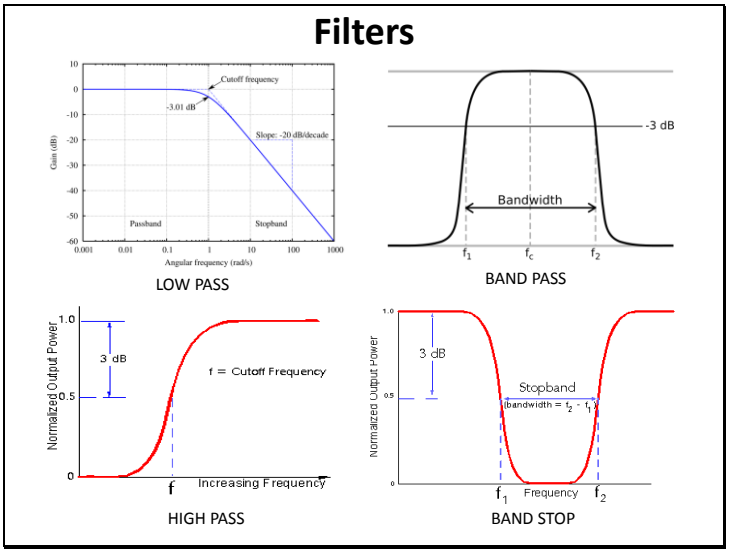

Sinusoidal Signal
Half-wave Rectification
Full-wave Rectification
+12v
0
-12v
t
AC
DC

Slide 8

Filter

- Electronic circuits which perform signal processing functions, specifically intended to remove unwanted signal components and/or enhance wanted ones
- Low-pass filter - Low frequencies are passed, high frequencies are attenuated **
- High-pass filter - High frequencies are passed, low frequencies are attenuated **
- Band-pass filter - Only frequencies in a frequency band are passed
- Band-stop filter - Only frequencies in a frequency band are attenuated **
- ** Attenuated or attenuation is the reduction in amplitude and intensity of a signal

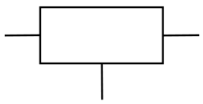
Slide 9


Filters
Cutoff frequency
-3.01 dB
Slope: -20 dB/decade
Gain (dB)
Passband
Stopband
Angular frequency (rad/s)
LOW PASS
-3 dB
Bandwidth
f_1
f_c
f_2
BAND PASS
Normalized Output Power
3 dB
f = Cutoff Frequency
f
Increasing Frequency
HIGH PASS
Normalized Output Power
3 dB
Stopband
(bandwidth = f_2 - f_1)
f_1
Frequency
f_2
BAND STOP

Slide 10

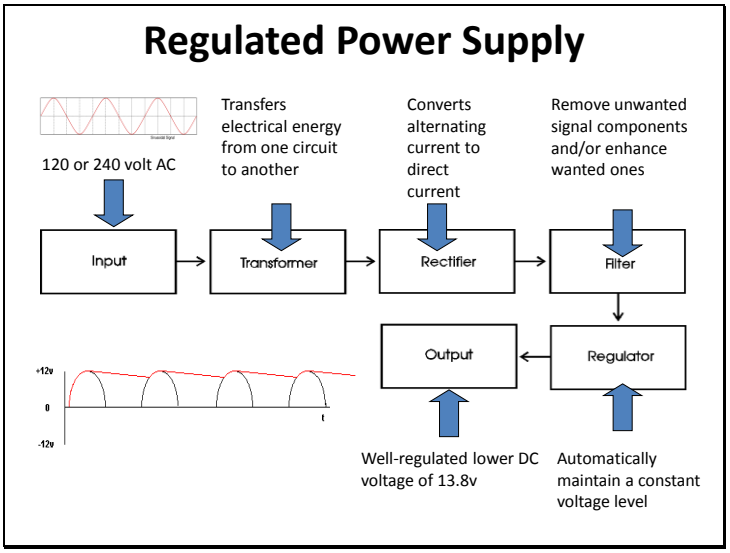
Regulator

- A voltage regulator is an electrical regulator designed to automatically <u>maintain a constant voltage level</u>.



Voltage-Regulator-IEC-Symbol

Slide 11


Regulated Power Supply
120 or 240 volt AC
Transfers electrical energy from one circuit to another
Converts alternating current to direct current
Remove unwanted signal components and/or enhance wanted ones
Input
Transformer
Rectifier
Filter
Regulator
Output
+12v
0
-12v
t
Well-regulated lower DC voltage of 13.8v
Automatically maintain a constant voltage level