

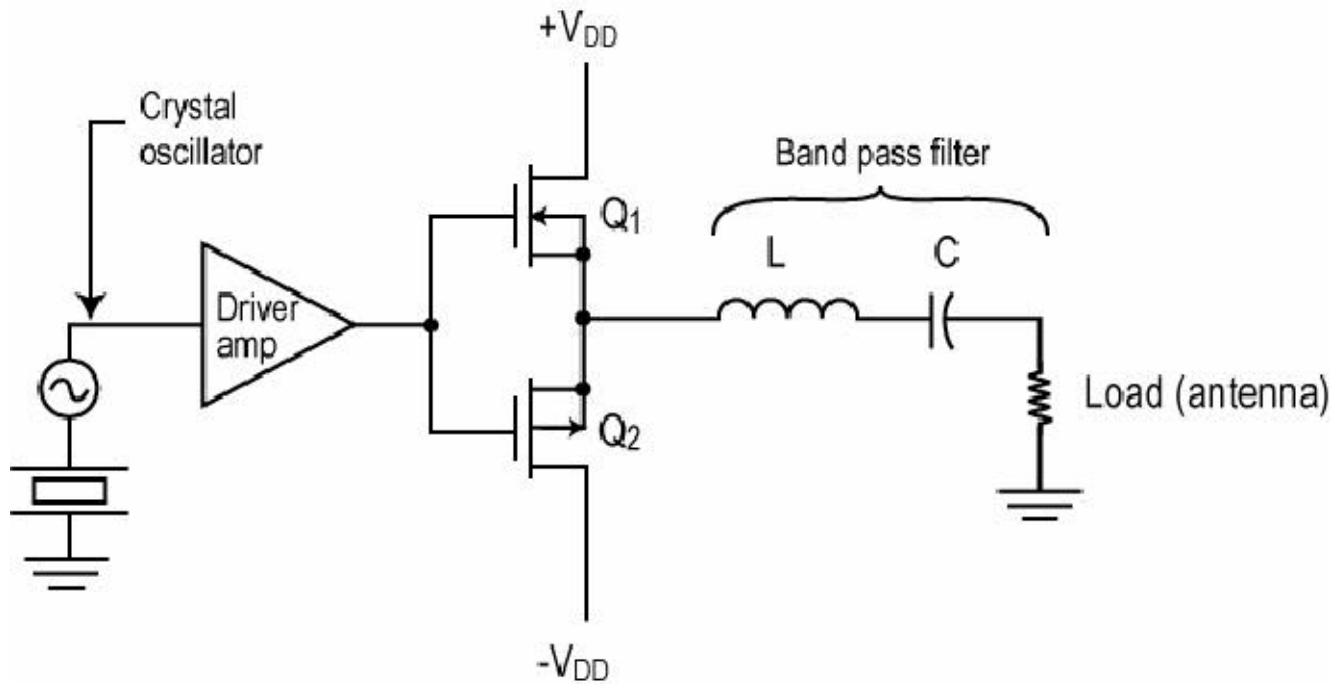
Switching RF Power Amplifiers

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The concept of a switching rather than a linear amplifier can also extend to radio frequency (RF) applications. Specifically, switching power amplifiers can be used in radio transmitters to boost signal levels up to hundreds of watts.

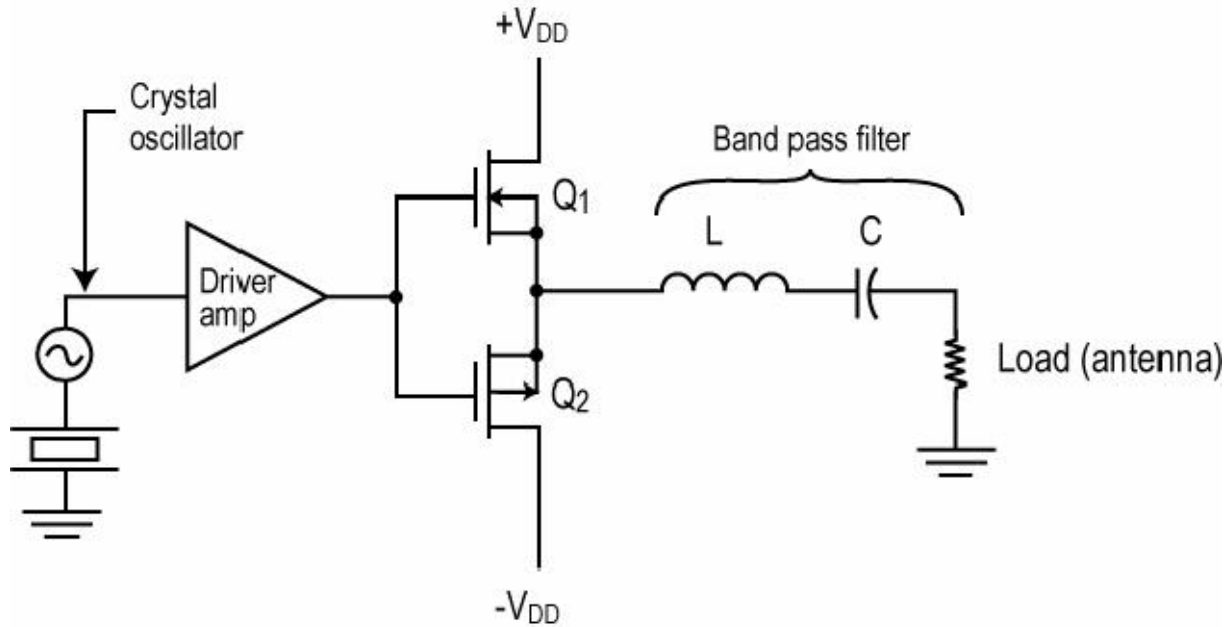
While many radio applications still require linear power amplification because of the complex broadband modulation schemes used, there are some applications where a switching RF amplifier is useable. Most of these applications use frequency modulation (FM) or some variation such as phase modulation (PM). Again, it is the high efficiency of a switching amplifier that makes it a beneficial choice.

RF Amplifier: Class D



A discussion of this graphic is presented in the pages that follow. You can print this graphic for study purposes before going on.

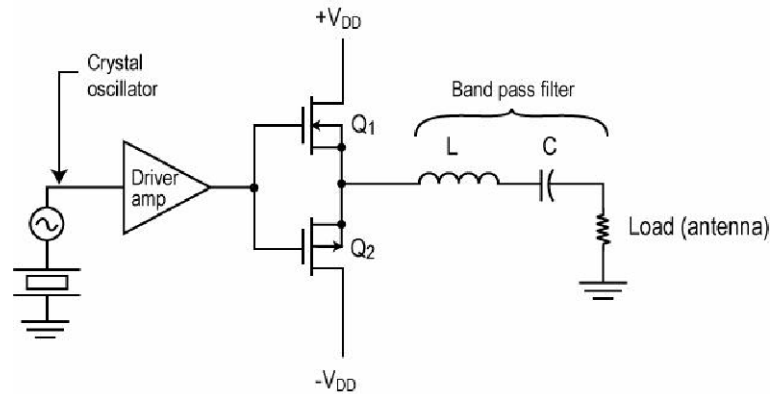
RF Amplifier: Class D



A class D RF power amplifier does not use PWM.

The basic RF signal is developed in a transmitter by a crystal oscillator or frequency synthesizer and increases its power to some desired level.

RF Amplifier: Class D

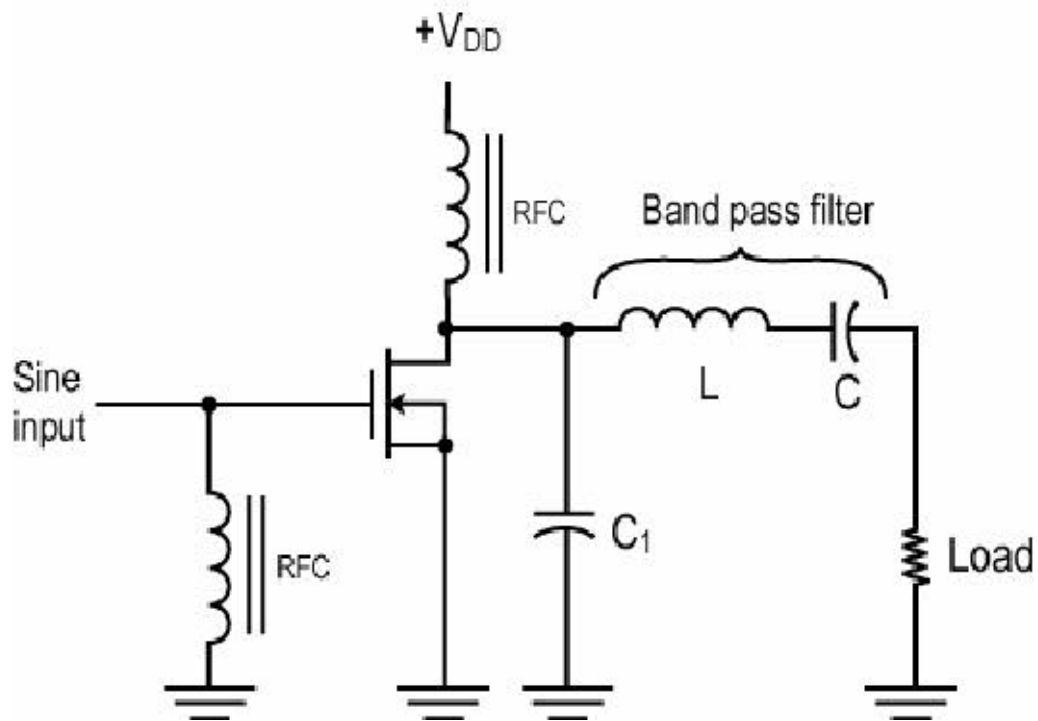


The MOSFETs feed the load, usually an antenna, through a series resonant circuit set to the operating frequency. The series LC circuit serves as a band pass filter to remove the higher level harmonics leaving a clean sine wave radio signal as the output.

The bandwidth of the series LC circuits is set by the circuit Q and is determined by the modulation scheme.

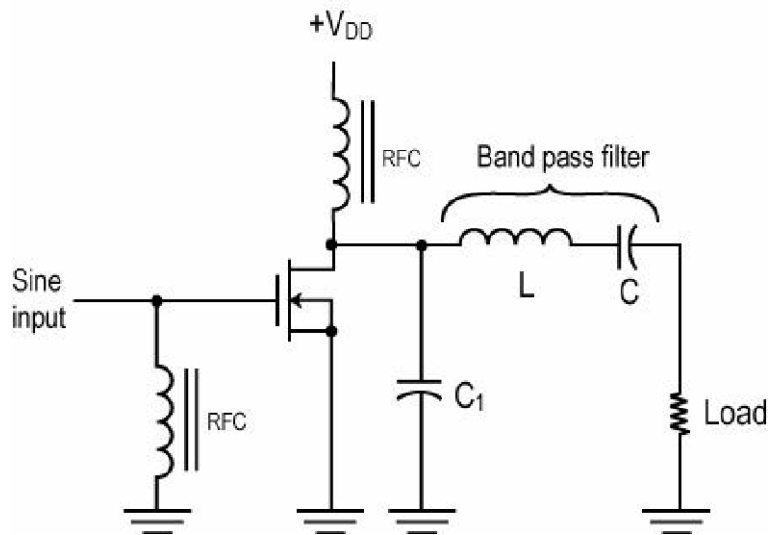
Over the years, high frequency MOSFETs have been developed to supply power up to several hundred watts at frequencies well above the 100 MHz range.

RF Amplifier: Class E



A discussion of this graphic is presented in the pages that follow. You can print this graphic for study purposes before going on.

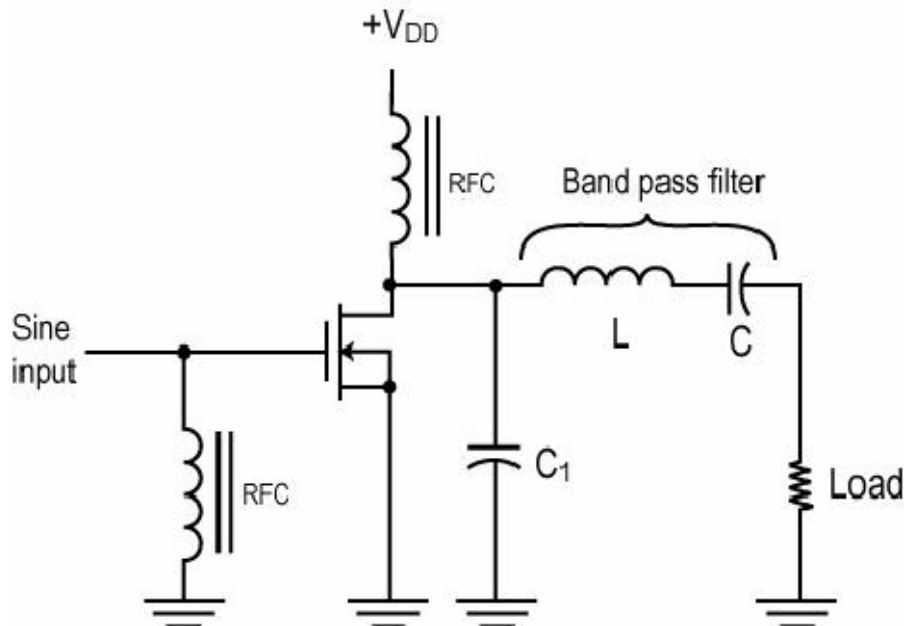
RF Amplifier: Class E



The class E RF switching amplifier circuit shown here normally uses a single MOSFET or bipolar transistor in a single-ended rather than push pull arrangement.

The sine wave RF signal to be amplified is applied to the transistor gate or base to turn the transistor off and on creating a square wave at the output.

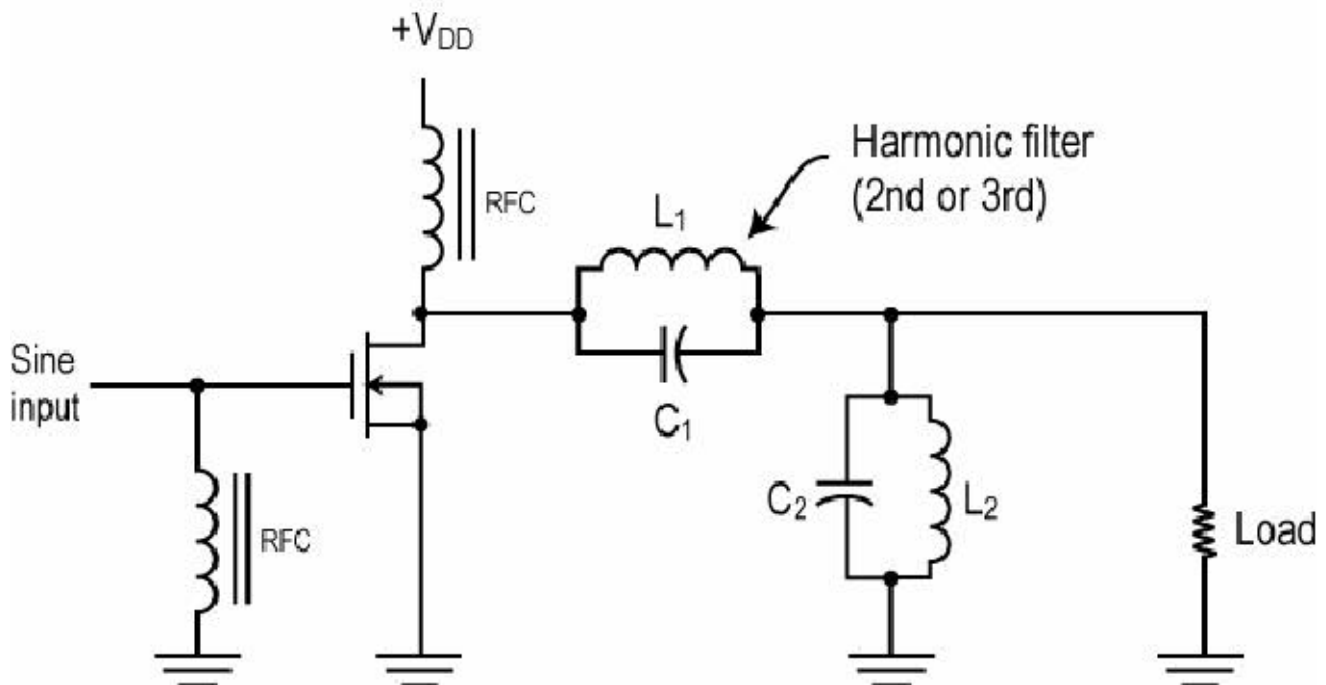
RF Amplifier: Class E



A series resonant circuit filters out the harmonics giving a sine wave output.

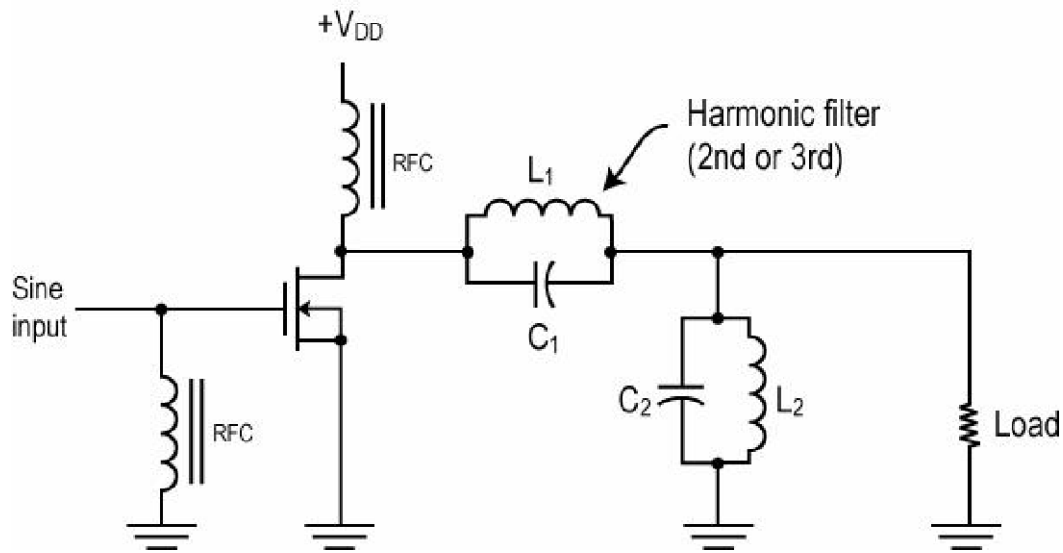
An additional capacitor C_1 is connected across the transistor to shorten the transistor switching times and improve efficiency.

RF Amplifier: Class F



A discussion of this graphic is presented in the pages that follow. You can print this graphic for study purposes before going on.

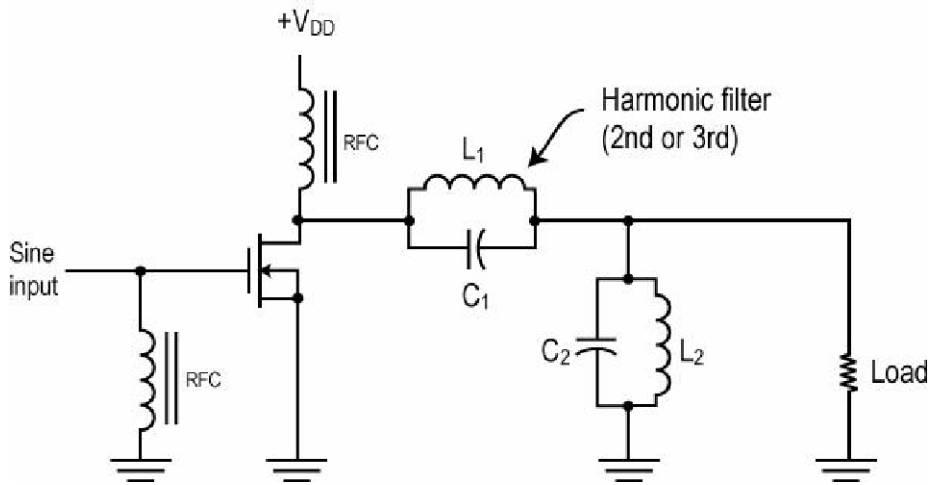
RF Amplifier: Class F



Like the class E amplifier, the class F RF amplifier uses a single-ended MOSFET or bipolar transistor and a tuned output circuit as a band pass filter.

The parallel resonant circuit L_2 - C_2 is set to the operating frequency and filters out the harmonics.

RF Amplifier: Class F



The tuned circuit L_1 - C_1 is set to the 2nd or 3rd harmonic frequency. The circuit is used to shape the output signal, shorten switching times, and improve efficiency.

Multiple additional tuned circuits may be added in series with L_1 - C_1 at each harmonic frequency to further improve efficiency.

In microwave amplifiers, these filters may be either stripline or microstrip transmission line filters.

Applications of Switching RF Power Amplifiers



The main application of class D, E, and F RF amplifiers is in portable FM radio communications equipment.

They are found in handheld radios used by police, fire, public service, military, and amateur radio personnel.

These amplifiers provide the high power needed while achieving efficiencies up to 90%. This preserves battery life and recharge time and permits smaller, lighter, minimal heat radios to be developed.

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Switching RF Power Amplifiers

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